ESTIMATES OF MARINE MAMMAL AND MARINE TURTLE CATCH BY THE US ATLANTIC PELAGIC LONGLINE FLEET IN 1994-1995.

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Summary

Estimates of the catch of marine mammals and sea turtles by the US Atlantic pelagic longline fleet permitted to land and sell Atlantic swordfish are based on logbook reported fishing effort levels and scientific observer records of catch rates from a representative sample of the fleet. Estimates are constructed using the Delta-lognormal method as described by Pennington (1983), taking into account possible geographical and time of year effects. The estimates ignore information that may be available in self-reported data on catch rates of marine mammals and marine turtles. Robustness of the estimates to geographical and time of year effects is examined by pooling across strata.

Point estimates of catch are relatively insensitive to this treatment of the data, but considerable gains in precision of the estimates can be attained in some cases by pooling across strata. The most precise estimates indicate that the US pelagic longline fleet operating in the Atlantic caught 216 (111-484, 95%CI) marine mammals in 1994 and 286(172-522, 95%CI) marine mammals in 1995. Of these, it is estimated that 0 marine mammals in 1994 and 7 (1-36, 95%CI) Risso's dolphins in 1995 were dead upon return to the sea. Most of the estimated catch of marine mammals came from US Atlantic EEZ waters between South Carolina and Cape Cod. It is also estimated that the fleet caught 2,166 (1,558-3,033, 95%CI) marine turtles in 1994 and 2,841 (2,127-3,824, 95%CI) marine turtles in 1995. Of these, it is estimated that 8 (1-41, 95%CI) loggerhead turtles in 1994 and 0 marine turtles in 1995 were dead upon return to the sea. Most of the estimated catch of marine turtles came from the Grand Banks (NED) fishing area, outside of the US EEZ.

Introduction.

Catch of non-targeted species (including marine mammals and sea turtles) in the US Atlantic longline fleet have been estimated via several methods. Witzell and Cramer (1995) applied a generalized linear model (GLM) using a Poisson error distribution assumption to model catch of marine turtles per set by US Atlantic longline vessels in 1992-1993. The data used in that analysis came from NMFS Southeast Fisheries Science Center (SEFSC, Lee *et.al.* 1994, Lee *et.al.* 1995) and Northeast Fisheries Science Center managed observer data sets, and self-reported records of catches of turtles and effort from the Atlantic Large Pelagic Logbook data set managed by the SEFSC (Farber 1990; Farber and Cramer 1992; Cramer 1993a, 1994a, 1995a, 1996a). This method was also applied to estimate marine mammal by-catch used in recent US Atlantic and Gulf of Mexico marine mammal stock assessment documents (Blaylock *et.al.* 1995), except that marine mammal self-reported catchs came from the Marine Mammal Exemption Program MM/Vessel Interactions database managed by the NMFS Office of Protected Resources (V. Cornish 12/7/94, pers. comm. to J. Cramer). In this case, the MMEP self-reported data were matched and merged with the Atlantic Large Pelagic Logbook data by vessel identifications and dates to provide a self-reported data base of marine mammal incidental catch and total fishing effort. The method applied to marine mammals and turtles allowed for estimating measures of uncertainty about catch and provided a basis for modeling spatio-temporal and gear effect patterns (*e.g.* the effect of light sticks or fishing depth) in the data by taking advantage of relatively larger sample sizes resulting from the self-reported data compared to the sample sizes available using only observed catch rates for these species (see for example Table 1 in Witzell and Cramer 1995).

An alternative method, a simple raising of the observed catch rates to the logbook reported effort, is summarized in Cramer (1995a) for calendar year 1993. This method was used to provide a national report to the International Commission for the Conservation of Atlantic Tunas on estimated total catch (including marine mammals and marine turtles) composition and disposition of the US Atlantic longline fleet in response to ICCAT's request for that information. The method ignores information on catch rates available from the MMEP and Atlantic Large Pelagic Logbook data sets and did not provide a measure of uncertainty in the estimated catch.

Some differences in estimates can result from ignoring the self-reported data. For instance, for 1993, the point estimate of marine mammal catches reported in Cramer (1995) is 236 animals, marginally outside the approximate 95% confidence range for estimated marine mammal catch in 1993 using a Poisson error GLM of the self-reported and observed data (243-553 animals). The simple raising estimate of marine turtle catch in 1993 is 1,307 animals (Cramer 1995), which is within the approximate 95% confidence range for estimated marine turtle catch in 1993 using the GLM approach was

1,089-2,276 (Witzell and Cramer 1995).

The estimates described in this report, are a modification of the simple raising method described above, but also provided are measures of uncertainty in the estimates of catch. The method is advantageous in that it is less complicated than the GLM approach, but at the possible expense of ignoring information in the self-reported data systems that might provide a basis for further refining the estimates through a structured hypothesis testing procedure.

The information presented herein is required by the National Marine Fisheries Service (NMFS) to meet its responsibility for management of interactions between protected species and commercial fisheries based on the level of incidental serious injury[1] and mortality. Estimates of animals killed based on observed mortality of protected species (*e.g.* marine mammals or marine turtles) by fisheries observers are provided as are estimates of total catch, which under a broad interpretation of the Marine Mammal Protection Act (MMPA) definition (see footnote 1), might be equated to estimates of injured marine mammals (Wade and Angliss 1997). Estimating the level of serious injury, however, requires additional knowledge to draw inference about the likelihood of death resulting from injuries incurred, as described by at-sea observers. This level of expert knowledge is as of yet, unavailable to the authors, although information summarized in this document could be useful to experts trained in veterinary medicine or other associated fields, in gaining insight into levels of serious injury for the observed, unintentional catch of protected species by US pelagic longline vessels operating in the Atlantic. It is anticipated that after the knowledge base for classifying seriously injured animals develops[2], estimating the numbers of protected species both killed *and* likely to die as a result of incidental capture by US pelagic longline vessels operating in the Atlantic will be possible.

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[1] Injury is specifically defined in the Code of Federal Regulations 229.2 which states: "*Injury* means a wound or other physical harm. Signs of injury include, but are not limited to, visible blood flow, loss of or damage to an appendage or jaw, inability to use one or more appendages, asymmetry in the shape of the body or body position, noticeable swelling or hemorrhage, laceration, puncture or rupture of eyeball, listless appearance or inability to defend itself, inability to swim or dive upon release from fishing gear, or signs of equilibrium imbalance. Any animal that ingests fishing gear, or any animal that is released with fishing gear entangling, trailing, or perforating any part of the body will be considered injured regardless of the absence of any wound or any other evidence of an injury."

Serious Injury is defined as meaning "any injury that will likely result in mortality."

[2] The need for a Serious Injury Workshop with objectives, among others, of identifying consistent criteria which might be used to identify marine mammals incidentally caught in various fisheries and injured to the extent that mortality is likely was identified in Wade and Angliss (1997). To this end, a NMFS-sponsored Serious Injury Workshop is planned for early spring, 1997.

Methods.

Data. Two types of data (observer based and self-reported) and 4 data bases were queried for accessability and utility for this analysis. Two data bases were scientific observer data collections (one maintained by the SEFSC and one maintained by the NEFSC) , the third was the Atlantic Large Pelagic mandatory logbook data base (maintained by the SEFSC) in which reports of daily fishing effort by the permitted fleet are made, and the fourth the Marine Mammal Exemption Program data base (maintained by NMFS Office of Protected Species).

Observer Data. Systematic scientific observer sampling of the US pelagic longline fleet in the Atlantic was implemented in 1992, under the authority of 1991 amendments to the US Fishery Management Plan for Swordfish, which included, among others, provisions for mandatory observer sampling on board vessels permitted under the FMP to land and sell Atlantic swordfish. With the advent of international agreements for management of pelagic fisheries, in order to assure compliance and to meet national goals, there was an obvious need to implement data collection systems which could be used to confirm and augment self-reported and port sampling programs.

The objective of the observer sampling is to provide a representative basis for estimating the total composition of the catch (retained and discarded, targeted and incidental). Among the demands on the data collected, are to provide estimates of the (dead) discarded catch of species for which harvests are restricted by regulation (*e.g.* undersized swordfish, billfishes, bluefin tuna, sharks, *etc.*), as well to provide estimates of unintentional catch of species protected from harvest by regulation (*e.g.* marine mammals, marine turtles, *etc.*).

In order to meet the objective, a simple, random sampling design was instituted (Cramer *et.al.* 1993). To derive a representative sample of the fleet, vessels were selected for observation, based on prior year performance information collected through the Atlantic Large Pelagic Logbook program (see below). The vessel selection process is based upon the amount of fishing effort (days fished) reported by permitted vessels and the selection is stratified by originally nine fishing areas (now eleven due to geographical expansion of the fleet, see Figure 1) and four calendar quarters. The probability of a vessel being selected for observation is proportional to the amount of effort reported for that vessel in the prior year-area-quarter. Vessels are sampled without replacement within a year-quarter (no single vessel is selected for observation more than one time per quarter). A target sampling level of 5% of the reported year-area-quarter effort was established based on available resources and estimated costs of the sampling.

Random draws of vessels selected for observation are made (Cramer et.al. 1993, Cramer 1993b, 1994b, 1995b, 1996b) and provided to the SEFSC and NEFSC observer field sampling programs which implement the design. At times, it is not possible to exactly implement the plan as drawn due to safety concerns, changes in vessel operations (no longer fishing, participating in another fishery, etc.), or other reasons. For this reason, an ordered draw representing 15% of prior year-area-quarter reported effort is provided to the field sampling programs.

During 1992-1995 field observer sampling was conducted by the SEFSC and the NEFSC. The SEFSC field sampling program for the longline fleet makes use of both NMFS and contracted field sampling program personnel. Data collected by the SEFSC filed sampling program are entered into a data base, quality controlled and managed by SEFSC staff (Lee *et.al.* 1994, 1995). The NEFSC field sampling program is primarily conducted through a sea sampling contractor and data entry and initial quality control are the responsibility of the contractor. Upon delivery from the contractor, additional audits and quality control as well as management of the data are performed by NEFSC staff.

Although the data collection systems used by the NEFSC and SEFSC field sampling programs are not identical, there is a high degree of overlap and each program collects information sufficient to characterize the composition, status and disposition of daily total catch and effort observed. For the purposes of this analysis, the total observed catch of marine mammals and marine turtles by pelagic longline vessels (Table 1) was classified by year, calendar quarter, fishing area, and condition of each animal upon release from the gear and return to the sea as either alive, dead, or unknown. In addition, information which may be useful for future evaluation of the odds of death due to injury incurred by marine mammals observed caught by pelagic longlines was also examined.

The geographical zones used to classify observed and reported longline fishing effort are shown in Figure 1. In general, these classifications are based on latitude and longitudes reported for the observations. In some cases, specific location (latitude and longitude) information was not available for observed catch and effort. In these cases, fishing areas (for catch and effort) were assigned based on examination of neighboring sets (neighboring days of fishing on the same trip), or examination of the individual data recording logs filled out by the observer. In cases where specific latitudes and longitudes could not be determined or extrapolated from neighboring days, latitudes and longitudes were assigned as the most frequently observed latitude and longitude in the data for the fishing area assigned. This procedure has no influence on stratum-wise estimates of catch, but can provide a somewhat false impression of the observed effort and catch density by smaller-scale geographic resolution (e.g. 1x1 degree summaries).

For the purposes of estimation, several coastal strata were combined, in keeping with Witzell and Cramer (1995) and Cramer (1995), which provided previous estimates of catch of marine turtles and marine mammals by this fishery. The Southeast Coastal (SEC) stratum was defined as areas 2 and 3 (Figure 1); the Northeast Coastal (NEC) stratum was defined as areas 5 and 6 (Figure 1); and the Offshore South (OFS) was defined as areas 8, 9, 10, and 11 (Figure 1). For reporting, and for testing the sensitivity of the estimation method to pooling, larger regions were also defined as those generally within the US Atlantic EEZ (US Atl: SEC plus NEC), other Atlantic waters (OthAtl: NED plus OFS plus CAR); and the Gulf of Mexico (GOM). Stratum-wise observed effort (for strata in which a marine mammal or sea turtle catch was observed) is shown in Table 2.

Self-Reported Data. Two self-reported data bases were queried for utility and availability for this analysis. The first queried was the Atlantic Large Pelagic Logbook data base maintained by the SEFSC. The second is the Marine Mammal Events Program data base maintained by the NMFS Office of Protected Resources.

SEFSC Large Pelagic Logbook Data: Daily logbook reports of catch and effort from permitted US vessels targeting large pelagic fishes have been required under the Atlantic Swordfish Fishery Management Plan since 1986. The SEFSC is responsible for entry, quality control and management of these data (Farber 1990, Farber and Cramer 1992, Cramer 1993a, 1994a, 1995a, 1996a). The fleet reporting under the permit system targets a number of species of tuna and swordfish and these data are utilized in fishery resource stock assessment analyses. Expansion of logbook reporting requirements to other fisheries, utilization of several gear types for targeting swordfish and tunas, and the open access nature of the fishery results in a large number of fishers presently reporting under this system which utilize gear other than pelagic longline and/or which target species other than swordfish and tunas.

The Large Pelagic Logbook data provide a basis for monitoring the permitted effort fished during the year and are used in this analysis as the sampling frame over which observed catch rates are expanded for estimating total catch. Although the total US pelagic longline fishing effort in the Atlantic fished during a year could differ from the logbook data, due for example, to errors in reporting, misclassification/misreporting of gears, or other reasons which could cause variations above or below summaries of the logbook effort reports, it has not yet been possible to implement independent sampling systems for estimating the possible error rates in the self-reported logbook effort data. Thus, the effort summaries from logbook data reports are taken as representing total effort expended during the year.

For the current analysis, daily fishing logbook reports for pelagic longline vessels targeting swordfish or tunas were defined as individual (daily) set records reporting at least 100 hooks fished, and which were not reported to be bottom longline sets or which did not indicate a target of sharks or species other than tunas or swordfish. The logbook effort data (hooks fished and days fished) were classified by fishing area (Figure 1, see definitions in preceding section) and calendar quarters. For logbook reports classified as pelagic longline effort for which no specific area of fishing could be assigned (due to missing location data), the effort reported was proportionally distributed amongst fishing areas based on the distribution of known location set records for the year and calendar quarter of the record. For unknown calendar quarter sets within a fishing area, the effort data was proportionally distributed amongst quarters based on the distribution of effort across quarters within an area. The stratum-wise reported levels of effort are shown in Table 2.

MMEP Data: Previous estimates (discussed above) of marine mammal and sea turtle catchs by the US Atlantic pelagic longline fleet utilized the spatio-temporal patterning of self-reported catch and effort data. The Marine Mammal Exemption Program (MMEP) data for 1994 and 1995, managed by the NMFS Office of Protected Resources were not available in time for this analysis.

Catch Estimation. Estimates of catch of marine mammals and marine turtles were constructed using the Delta-lognormal method described by Pennington (1983). The method assumes a lognormal distribution of the positive catch rate observations. Effectively, the estimates are constructed as a product of the proportion of successful occurrences of an event and the average rate at which the event occurs for those successful events. The variance is a function of the variability of the positive catch rates as well the number of successful and unsuccessful sets. Total catch in each fishing region (see Figure 1) and calendar quarter for species or species groups of concern (C_t), was estimated as:

$$C_t = H\frac{m_c}{N}e^{L}G_{m_c}(s_L^2), \tag{1}$$

where H is the number of hooks reported set per analytical stratum, divided by 1000; m_c, the number of sets upon which a catch of the species or species group of concern was observed; N the total number of sets observed per analytical stratum; L, the average of the m_c observations of $\log_e$-transformed catch per 1000 hooks fished; s_L^2, the sample variance of the $\log_e$-transformed positive catch rates; and the function $G_{mc}(.)$ is the cumulative probability from the Poisson distribution:

$$G_{m_c}\left(\frac{s_L^2}{2}\right) = 1 + \frac{m_c-1}{m_c}\left(\frac{s_L^2}{2}\right) + \sum_{j=2}^{\infty} \frac{(m_c-1)^{2j-1}}{m_c^j(m_c+1)(m_c+3)\dots(m_c+2j-3)j!}\,\frac{\left(\frac{s_L^2}{2}\right)^j}{j!}. \tag{2}$$

Numerically, the series was computed over j terms, until a convergence criterion of <0.001 change in the function was achieved (usually less than 10 terms were required). The estimate of variance of the catch takes the form:

$$V(C_t)=(H\frac{m_c}{N}e^{L})^2[\frac{m_c}{N}G_{m_c}^2(\frac{s_L^2}{2})-(\frac{m_c-1}{N-1})G_{m_c}(\frac{m_c-2}{m_c-1}s_L^2)]. \tag{3}$$

Estimates of catch by stratum were assumed independent and as such estimated catch and the associated variances were summed across strata to produce region-wide annual estimates. The coefficient of variation for the stratum-wise estimate of catch was taken as:

$$CV=\frac{\sqrt{\frac{V(C_t)}{N-1}}}{C_t} \tag{4}$$

and approximate 1-α confidence intervals were constructed assuming a log-normal distribution as: $(U_{1-\alpha/2},L_{1-\alpha/2})=(C_t k, C_t/k)$, where $U_{1-\alpha/2}$ and $L_{1-\alpha/2}$ represent the upper and lower confidence bounds, $k=\exp[z_\alpha(\log_e(1+CV^2))^{1/2}]$, and z_α, the associated 1-α z-score.

Estimates of animals returned to the sea dead and returned to the sea alive were likewise constructed, except that the appropriate number of positive sets, average log-transformed catch rates and variance terms were substituted into equations 1-4 above. Additionally, the robustness of the estimates to pooling across calendar quarters, large geographical regions, and within coarser taxonomic groupings (i.e. marine mammals and marine turtles) was examined. Also in these cases, the appropriate number of positive catch sets, average ($\log_e$) catch rates and variance terms were substituted.

Expected Precision. Expected levels of precision for the data and estimation methods used herein were modelled as a function of the proportion of positive sets and the stratum-wise sampling fraction. A GLM using a lognormal error assumption was applied to the stratified estimates of coefficients of variation (year-area-quarter- and lowest taxonomic grouping) of the catch of all species observed for the data ranging from 1992-1995, controlling for the proportion of positive sets and sampling fractions (observed sets/logbook reported sets) for each area-year-quarter stratum as defined above. The resulting model predicitions were used to evaluate the relative contribution to precision of the two components for the species observed in this fishery.

Results and Discussion

Previous estimates of marine mammal and marine turtle catch by US pelagic longline vessels operating in the Atlantic made use of both self-reported and observed catch rates of these species. A GLM was applied to model area and time as well as gear effects on catch of these species. For this analysis, self-reported marine mammal catch rate information for 1994-1995 was not available. As there was no basis for examining the self-reported nature for marine mammal catch, self-reported information on turtles was not utilized either, to maintain consistency in methods. The method applied (Delta-lognormal), is a modification of a simple raising of observed catch rates to total effort previously applied (Cramer 1995a), taking fishing area and calendar quarter effects into account. Estimates of uncertainty about the catches are also provided. The method is advantageous in that it is less complicated than the GLM approach, but at the possible expense of ignoring information in the self-reported data systems that might provide a basis for further refining the estimates through a structured hypothesis testing procedure.

Stratum-specific reported and observed effort statistics for 1994 and 1995 wherein either a marine mammal or a marine turtle was observed caught (see Table 1 for a listing of the year-area-quarter-species strata events) are shown in Table 2. For these strata, the sampling fractions (AQSETS/LOGSETS, Table 2) ranged from about 1% to 30%, and averaged 7.6% in 1994 and 6.5% in 1995. Sampling fractions in 1996 and 1997 are expected to be substantially lower than these levels since resources available for Atlantic-wide longline observer activities have been reduced to about 1/3 of the 1994-95 levels. As noted above, the logbook reported effort as defined for this analysis might not equate to the total pelagic longline fishing effort expended in 1994 and 1995. Differences could be due to reporting errors, misclassification of gear types in the analysis, or other reasons. The direction and magnitude of difference between the logbook reported (as herein defined) and actual effort cannot be predicted on the basis of present information. If actual effort expended is greater than indicated in Table 2, then the resulting estimates of catch would be higher. Likewise, if the actual effort expended was lower than indicated in Table 2, then the estimates of catch would be lower.

The distributions of reported effort density (hooks per 1x1 degree block) for 1994 and 1995 are shown in Figure 2. Similarly, distributions of observed effort (hooks per 1x1 degree block) for 1994 and 1995 are shown in Figure 3. A broader distribution of observed effort in the NED fishing area (see Figures 1 and 3) was likely made than indicated in Figure 3, but the specific position information for a number of the observed set locations in this fishing region were not available at the time of this analysis and positions were assigned (to the same 1x1 degree block) for the purpose of plotting. However, this has no effect on the estimation of catch conducted in this analysis.

The distributions of observed marine mammal and marine turtle catches for 1994 and 1995 are shown in Figures 4 and 5 (see Table 1 for a listing of the observations). In

Figure 4, the size of the symbol used is proportional to the observed catch of marine mammals in each 1x1 degree block indicated for 1994 and 1995. In 1994, 24 marine mammals were observed caught (Table 1). These catches occurred on 19 different fishing operations (sets) and the observed positive catch ranged from 1 to 5 animals on a single set, although on 17 of the 19 sets, only one animal was observed caught. In 1995, 20 marine mammals were observed caught (Table 1). The 1995 observed catches occurred on 19 different sets (18 sets caught 1 animal and 1 set caught 2 animals). Most of the marine mammals observed caught were from US Atlantic EEZ waters ranging from off the coast of South Carolina to east of Cape Cod (Figure 4). The most common species observed caught were pilot whales (*Globicephala* spp.), which accounted for 30 of the 44 observed animals in 1994 and 1995. Risso's dolphin (*Grampus griseus*) ranked second (10 animals observed). Three other species (1 Pantropical spotted dolphin, *Stenella attenuata*; 1 Atlantic spotted dolphin, *Stenella frontalis*; and 1 killer whale, *Orcinus orca*) and one unidentified marine mammal comprised the remainder of the observed marine mammal catch in 1994 and 1995 (see Table 1). During these two years, only one marine mammal that was observed caught was dead upon its return to the sea (a Risso's dolphin caught in the MAB fishing area in 1994, Table 1). The condition of 1 animal observed, but returned to the sea was unknown, while the remaining 42 animals were observed to be living when returned to the sea.

Observed turtle catches were considerably larger than marine mammal catches (Table 1, Figure 5). In Figure 5, the size of the symbol is proportional to the number of turtles observed caught by 1x1 degree block, except as noted for the NED fishing area (Figure 1), due to much higher average per set catches observed in that area. In 1994, a total of 134 marine turtles were observed on 77 sets (Table 1) and for these, the number of turtles caught per set ranged from 1 to 7 (46 sets caught 1 turtle, 9 caught 2, 7 caught 3, 1 caught 4, 4 caught 5, 3 caught 6, and 1 caught 7). In 1995, 192 marine turtles were observed caught (Table 1). The 1995 observed catches occurred on 89 different sets and on these, the number of turtles caught per set ranged from 1-8 (a total of 48, 15, 8, 8, 5, 3, 1, and 1 sets caught 1, 2, 3, 4, 5, 6, 7, and 8 turtles, respectively). Most of the marine turtles observed caught were from Atlantic waters outside of the US EEZ (specifically the NED fishing area, Figures 1 and 5). The most common species observed caught were loggerhead turtles (*Caretta caretta*), which accounted for 209 of the 326 observed animals in 1994 and 1995. Leatherback turtles (*Dermochelys coriacea*) ranked second (103 animals observed) to loggerheads. In terms of relative frequency of occurrence, the 1994 and 1995 observations are consistent with those for 1992 and 1993 (Witzell and Cramer 1995, Cramer 1995a). Two other species (7 green turtles, *Chelonia mydas* ; and 1 Kemp's ridley, *Lepidochelys kempi*) and 6 unidentified marine turtles comprised the remainder of the observed marine turtle catch in 1994 and 1995 (Table 1). Witzell and Cramer (1995) also noted the occurrence of turtles identified as green and Kemp's ridley in the 1992-1993 observer records and indicated that these species identifications were questionable.

Estimates of marine mammal and marine turtle catches by the US pelagic longline fleet operating in the Atlantic in 1994-1995 are shown in Tables 3-5. Table 3 presents stratum-specific (year, calendar quarter, fishing area, and lowest taxonomic grouping available) estimates of total catch, catch observed dead, and catch observed to be alive upon return to the sea. Estimates of "unknown condition" catch are not shown in the tables, but can be calculated as the difference between the total catch and the sum of the dead and alive category catches.

Marine mammals were observed caught on from 1% to 8% of the stratum-wise observed sets (for those year-area-quarter strata in which marine mammals wer observed (column PPC in Table 3). Overall, at least one marine mammal was observed caught on 2.3% of observed sets in 1994 and 1995 (see Table 6a for total sets observed per year). The proportion of observed sets on which at least one turtle was caught was higher than that for marine mammals. Marine turtles were observed caught on from 1% to 89% of the stratum-wise observed sets (column PPC in Table 3). Overall, at least one marine turtle was observed caught on 9.9% of the observed sets in 1994 and 1995. The NED fishing area (Figures 1 and 4) stood out with generally high proportions of observed sets on which at least one turtle was caught. Witzell and Cramer (1995) point out that some turtles observed caught in 1992-1993 had one or more hooks imbedded, indicating the possibility that some turtles may be caught multiple times. Thus, estimates of marine turtle catch might overestimate to some unknown (but presumably small) degree, the number of different individuals caught by the fleet.

Annual estimates of marine mammal and marine turtle catches for the fishing area strata used in the analysis and for the lowest taxonomic grouping available in the data are shown in Table 4. Annual estimates for larger ocean areas (Guld of Mexico waters, US Atlantic EEZ waters, and other Atlantic waters) are provided in Table 5.

The estimates and associated coefficients of variation in Tables 3-5 are based on estimation by year-area-quarter strata for the lowest taxonomic groupings available in the data. Robustness of the estimates to geographical and time of year effects was examined by pooling across strata. Estimates of catch in Table 6 were constructed by pooling within years, within the large ocean areas used in Table 5 and within the general taxonomic categories of marine mammals and marine turtles. Figure 6 contrasts the resulting estimates by the stratified approach (Tables 3-5) and the pooling approach (Table 6). It is apparent in examining Figure 6 that the point estimates of catch are relatively insensitive to this treatment of the data, but that considerable gains in precision of the estimates can be attained by pooling (also compare Tables 5 and 6).

The most precise estimates (summing across regions in Table 6) indicate that the US pelagic longline fleet operating in the Atlantic caught 216 (111-484, 95%CI) marine mammals in 1994 and 286(172-522, 95%CI) marine mammals in 1995. Of these, it is estimated that 0 marine mammals in 1994 and 7 (1-36, 95%CI) Risso's dolphins in 1995 were dead upon return to the sea. Most of the estimated catch of marine mammals came from US Atlantic EEZ waters between South Carolina and Cape Cod. It is also estimated that the fleet caught 2,166 (1,558-3,033, 95%CI) marine turtles in 1994 and 2,841 (2,127-3,824, 95%CI) marine turtles in 1995. Of these, it is estimated that 8 (1-41, 95%CI) loggerhead turtles in 1994 and 0 marine turtles in 1995 were dead upon return to the sea. Most of the estimated catch of marine turtles came from the Grand Banks (NED) fishing area, outside of the US EEZ.

It is unlikely that estimates of catch for 1996 and 1997 will be as precise as those presented in this analysis. During 1996 and through 1997, resources for field sampling of the pelagic longline fleet have been reduced by about 66%, with a concomitant reduction in realized and expected observer sampling of the fleet (Figure 7). Results of a loglinear model fit to the estimated precision of the estimates of all species observed caught (the total catch composition) provides an empirical basis for predicting the precision of estimates of catch as a function of the frequency of occurrence and the sampling fraction (Table 7). It is evident in Table 7, that the highest proportion of variability explained in $\log_e$-transformed coefficients of variation is attributable to the proportion of positive catch observations (variable BIN in Table 7). Although additional variablility in the $\log_e$-transformed CV estimates could likely be explained using fishing area and time of year effects, as well as other variables that relate to the catchability of different species, Figure 8 demonstrates that for rare event species (such as marine mammals with an overall average of about 2.3% occurrence and marine turtles with an overall average of about 10% occurrence), attaining stratified estimates with precision less than 50% would on average, require large fractions of the total effort fished to be observed. The reduction in level of observer coverage for the US Atlantic pelagic longline fleet will likely increase the need for heavier reliance on self-reported data and the application of GLM-like methods which can accomodate highly unbalanced sampling designs, for estimating catches of non-targeted and rare event species by the fleet.

Information useful for classifying marine mammals as injured according to the MMPA definition of injury (see footnote 1) is generally recorded as condition codes by NEFSC observers and as comments made by observers on field data sheets (by both SEFSC and NEFSC observers). The available information for marine mammals observed caught in 1994 and 1995 is provided in Table 8. As the MMPA definition can be broadly interpreted to mean that any marine mammal caught is injured in some way, estimates of total catch could be equated with estimates of the numbers of animals injured and killed. Estimates of the numbers of animals "seriously injured", however, would require subjective (and for the authors who are not expert in veterinary medicine, possibly inappropriate) decisions about what observational data woud indicate injury of sufficient severity to significantly increase the near-term probability of death of the animal. This difficulty is identified by Wade and Angliss (1997), who recommend convening a meeting of experts to address the issue and to recommend research programs that could provide objective and consistent criteria that might be used by observers to classify marine mammals into such a category. It is anticipated that after the knowledge base for classifying seriously injured animals develops, estimating the numbers of protected species both killed *and* likely to die as a result of incidental capture by US pelagic longline vessels operating in the Atlantic will be possible.

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Table 1. Marine mammal and marine turtle observed catches for 1994-1995 from pelagic longline vessel trips used in this analysis. SOURCE indicates the data base from which the observation was obtained (NE=NEFSC; SE=SEFSC). Also indicated are the y (YR), calendar quarter (QUARTR), fishing area (AREA), vessel trip identifier (TRIP), haul on which catch was observed (HAULNM), the number of hooks set (HOOKS), the total number of animals involved (ANIMLS) and the number that were classified by the obser as alive, dead, or of unknown condition upon return back to the sea.

SOURCE	GROUP	COMMON	YR	QUARTR	AREA	TRIP	HAULNM	HOOKS	ANIMLS	ALIVE	DEAD	U
Marine Mammals:												
NE	MARINE MAMMAL	PILOT WHALE	94	1	MAB	A02	1	840	1	0	0	
NE	MARINE MAMMAL	DOLPHIN RISSOS	94	3	MAB	A32008	2	880	1	0	1	
NE	MARINE MAMMAL	DOLPHIN RISSOS	94	3	MAB	A44004	6	672	1	1	0	
NE	MARINE MAMMAL	PILOT WHALE	94	3	MAB	A28030	3	586	1	1	0	
NE	MARINE MAMMAL	PILOT WHALE	94	3	MAB	A28030	10	768	1	1	0	
NE	MARINE MAMMAL	PILOT WHALE	94	3	MAB	A44004	4	850	1	1	0	
NE	MARINE MAMMAL	PILOT WHALE	94	3	MAB	A44004	5	768	1	1	0	
NE	MARINE MAMMAL	PILOT WHALE	94	3	MAB	A44004	7	768	1	1	0	
NE	MARINE MAMMAL	PILOT WHALE	94	4	MAB	A54005	1	1296	2	2	0	
NE	MARINE MAMMAL	DOLPHIN RISSOS	94	3	NEC	A44004	8	768	1	1	0	
NE	MARINE MAMMAL	PILOT WHALE	94	3	NEC	A53037	13	803	1	1	0	
NE	MARINE MAMMAL	DOLPHIN RISSOS	94	4	NEC	A62002	3	630	1	1	0	
NE	MARINE MAMMAL	DOLPHIN RISSOS	94	4	NEC	A62002	7	672	1	1	0	
NE	MARINE MAMMAL	DOLPHIN RISSOS	94	4	NEC	A62002	9	672	1	1	0	
NE	MARINE MAMMAL	KILLER WHALE	94	4	NED	A54003	15	960	1	1	0	
NE	MARINE MAMMAL	PILOT WHALE	94	3	SAB	A32006	2	775	5	5	0	
NE	MARINE MAMMAL	PILOT WHALE	94	3	SAB	A32006	3	345	1	1	0	
NE	MARINE MAMMAL	DOLPHIN RISSOS	95	3	MAB	A44040	9	850	1	1	0	
NE	MARINE MAMMAL	DOLPHIN RISSOS	95	3	MAB	A44043	3	653	1	1	0	
NE	MARINE MAMMAL	DOLPHIN RISSOS	95	3	MAB	A44043	11	490	1	1	0	
NE	MARINE MAMMAL	PILOT WHALE	95	3	MAB	A44040	5	925	1	1	0	
NE	MARINE MAMMAL	PILOT WHALE	95	3	MAB	A62058	1	588	1	1	0	
NE	MARINE MAMMAL	PILOT WHALE	95	3	MAB	A62058	4	630	1	1	0	
NE	MARINE MAMMAL	PILOT WHALE	95	3	MAB	A41032	5	650	1	1	0	
NE	MARINE MAMMAL	PILOT WHALE	95	3	MAB	A44043	6	700	1	1	0	
NE	MARINE MAMMAL	PILOT WHALE	95	3	MAB	A62071	1	478	1	1	0	
NE	MARINE MAMMAL	SHORTFIN PILOT WHALE	95	3	MAB	A62071	2	478	1	1	0	
NE	MARINE MAMMAL	PILOT WHALE	95	4	MAB	A41034	1	1000	1	1	0	
NE	MARINE MAMMAL	PILOT WHALE	95	4	MAB	A41034	7	1000	1	1	0	
NE	MARINE MAMMAL	PILOT WHALE	95	4	MAB	A41034	8	1000	2	2	0	
NE	MARINE MAMMAL	DOLPHIN RISSOS	95	3	NEC	A41031	9	950	1	1	0	
NE	MARINE MAMMAL	PILOT WHALE	95	3	NEC	A25041	9	770	1	1	0	
NE	MARINE MAMMAL	PILOT WHALE	95	3	NEC	A41031	6	900	1	1	0	
NE	MARINE MAMMAL	PILOT WHALE	95	3	NED	A53034	15	561	1	1	0	
SE	MARINE MAMMAL	DOLPHIN PANTROPIC SPOTTED	94	2	GOM	F15	6	691	1	1	0	
SE	MARINE MAMMAL	DOLPHIN ATLANTIC SPOTTED	94	3	GOM	F16	7	810	1	1	0	
SE	MARINE MAMMAL	MARINE MAMMAL	95	3	MAB	F29	5	635	1	1	0	
SE	MARINE MAMMAL	PILOT WHALE	95	4	FEC	T12	3	357	1	1	0	
Marine Turtles:												
NE	MARINE TURTLE	TURTLE KEMPS RIDLEY	94	3	MAB	A53037	6	596	1	1	0	
NE	MARINE TURTLE	TURTLE LEATHERBACK	94	3	MAB	A44004	3	672	1	1	0	
NE	MARINE TURTLE	TURTLE LEATHERBACK	94	3	MAB	A53037	5	803	1	1	0	
NE	MARINE TURTLE	TURTLE LOGGERHEAD	94	3	MAB	A32005	1	875	1	1	0	
NE	MARINE TURTLE	TURTLE LEATHERBACK	94	4	MAB	A25018	2	580	2	2	0	
NE	MARINE TURTLE	TURTLE LEATHERBACK	94	4	MAB	A25018	9	600	1	1	0	
NE	MARINE TURTLE	TURTLE LEATHERBACK	94	4	MAB	A24018	5	870	1	1	0	
NE	MARINE TURTLE	TURTLE LOGGERHEAD	94	4	MAB	A41052	6	750	1	0	1	
NE	MARINE TURTLE	TURTLE GREEN	94	2	NEC	A44001	6	1000	1	1	0	
NE	MARINE TURTLE	TURTLE GREEN	94	2	NEC	A44001	8	480	1	1	0	
NE	MARINE TURTLE	TURTLE GREEN	94	3	NEC	A31003	8	590	1	1	0	
NE	MARINE TURTLE	TURTLE LEATHERBACK	94	3	NEC	A31003	4	600	1	1	0	
NE	MARINE TURTLE	TURTLE LEATHERBACK	94	3	NEC	A31003	9	590	1	1	0	
NE	MARINE TURTLE	TURTLE LEATHERBACK	94	3	NEC	A31003	10	600	1	1	0	
NE	MARINE TURTLE	TURTLE LOGGERHEAD	94	4	NEC	A62002	2	685	1	1	0	
NE	MARINE TURTLE	TURTLE	94	3	NED	A44002	7	960	1	1	0	
NE	MARINE TURTLE	TURTLE GREEN	94	3	NED	A44002	1	960	1	1	0	
NE	MARINE TURTLE	TURTLE LEATHERBACK	94	3	NED	A44002	1	960	1	1	0	
NE	MARINE TURTLE	TURTLE LOGGERHEAD	94	3	NED	A44002	1	960	1	1	0	
NE	MARINE TURTLE	TURTLE LOGGERHEAD	94	3	NED	A44002	2	960	1	1	0	
NE	MARINE TURTLE	TURTLE LOGGERHEAD	94	3	NED	A44002	5	960	1	1	0	
NE	MARINE TURTLE	TURTLE LOGGERHEAD	94	3	NED	A44002	6	960	1	1	0	
NE	MARINE TURTLE	TURTLE LOGGERHEAD	94	3	NED	A44002	7	960	1	1	0	
NE	MARINE TURTLE	TURTLE LOGGERHEAD	94	3	NED	A44002	8	960	2	2	0	
NE	MARINE TURTLE	TURTLE LOGGERHEAD	94	3	NED	A44002	9	960	1	1	0	
NE	MARINE TURTLE	TURTLE LOGGERHEAD	94	3	NED	A44002	10	960	2	2	0	
NE	MARINE TURTLE	TURTLE LOGGERHEAD	94	3	NED	A44002	11	960	6	6	0	
NE	MARINE TURTLE	TURTLE LOGGERHEAD	94	3	NED	A44002	12	960	2	2	0	
NE	MARINE TURTLE	TURTLE LOGGERHEAD	94	3	NED	A44002	13	960	6	6	0	
NE	MARINE TURTLE	TURTLE LOGGERHEAD	94	3	NED	A44002	14	960	3	3	0	
NE	MARINE TURTLE	TURTLE LOGGERHEAD	94	3	NED	A44002	15	960	4	4	0	
NE	MARINE TURTLE	TURTLE LOGGERHEAD	94	3	NED	A44002	16	960	1	1	0	
NE	MARINE TURTLE	TURTLE LOGGERHEAD	94	3	NED	A44002	17	960	7	7	0	

Table 1. Continued.

NE	MARINE TURTLE	TURTLE LOGGERHEAD	94	3	NED	A44002	18	1000	3	3	0	0
NE	MARINE TURTLE	TURTLE LEATHERBACK	94	4	NED	A54003	4	960	1	1	0	0
NE	MARINE TURTLE	TURTLE LEATHERBACK	94	4	NED	A54003	6	1032	4	4	0	0
NE	MARINE TURTLE	TURTLE LEATHERBACK	94	4	NED	A54003	9	960	1	1	0	0
NE	MARINE TURTLE	TURTLE LEATHERBACK	94	4	NED	A54003	10	960	1	1	0	0
NE	MARINE TURTLE	TURTLE LEATHERBACK	94	4	NED	A54003	11	960	1	1	0	0
NE	MARINE TURTLE	TURTLE LEATHERBACK	94	4	NED	A54003	12	960	2	2	0	0
NE	MARINE TURTLE	TURTLE LEATHERBACK	94	4	NED	A54003	13	864	1	1	0	0
NE	MARINE TURTLE	TURTLE LEATHERBACK	94	4	NED	A54003	16	960	1	1	0	0
NE	MARINE TURTLE	TURTLE LEATHERBACK	94	4	NED	A54003	19	960	1	1	0	0
NE	MARINE TURTLE	TURTLE LEATHERBACK	94	4	NED	A53040	3	1088	1	1	0	0
NE	MARINE TURTLE	TURTLE LOGGERHEAD	94	4	NED	A54003	2	720	3	3	0	0
NE	MARINE TURTLE	TURTLE LOGGERHEAD	94	4	NED	A54003	3	720	2	2	0	0
NE	MARINE TURTLE	TURTLE LOGGERHEAD	94	4	NED	A54003	5	960	1	1	0	0
NE	MARINE TURTLE	TURTLE LOGGERHEAD	94	4	NED	A54003	6	1032	1	1	0	0
NE	MARINE TURTLE	TURTLE LOGGERHEAD	94	4	NED	A54003	7	576	3	3	0	0
NE	MARINE TURTLE	TURTLE LOGGERHEAD	94	4	NED	A54003	8	960	1	1	0	0
NE	MARINE TURTLE	TURTLE LOGGERHEAD	94	4	NED	A54003	10	960	2	2	0	0
NE	MARINE TURTLE	TURTLE LOGGERHEAD	94	4	NED	A54003	11	960	4	4	0	0
NE	MARINE TURTLE	TURTLE LOGGERHEAD	94	4	NED	A54003	12	960	3	3	0	0
NE	MARINE TURTLE	TURTLE LOGGERHEAD	94	4	NED	A54003	14	864	3	3	0	0
NE	MARINE TURTLE	TURTLE LOGGERHEAD	94	4	NED	A54003	15	960	6	6	0	0
NE	MARINE TURTLE	TURTLE LOGGERHEAD	94	4	NED	A54003	16	960	1	1	0	0
NE	MARINE TURTLE	TURTLE LOGGERHEAD	94	4	NED	A53040	1	542	1	1	0	0
NE	MARINE TURTLE	TURTLE LOGGERHEAD	94	4	NED	A53040	6	1191	1	1	0	0
NE	MARINE TURTLE	TURTLE LOGGERHEAD	94	4	NED	A53040	13	1191	5	5	0	0
NE	MARINE TURTLE	TURTLE LOGGERHEAD	94	4	NED	A53040	16	1031	1	1	0	0
NE	MARINE TURTLE	TURTLE LOGGERHEAD	94	4	NED	A53040	18	975	1	1	0	0
NE	MARINE TURTLE	TURTLE LEATHERBACK	95	1	MAB	A24001	3	1000	1	1	0	0
NE	MARINE TURTLE	TURTLE GREEN	95	2	MAB	A32006	11	960	1	1	0	0
NE	MARINE TURTLE	TURTLE LEATHERBACK	95	2	MAB	A25038	9	600	1	1	0	0
NE	MARINE TURTLE	TURTLE LOGGERHEAD	95	2	MAB	A25038	3	720	2	2	0	0
NE	MARINE TURTLE	TURTLE LOGGERHEAD	95	2	MAB	A25038	4	720	1	1	0	0
NE	MARINE TURTLE	TURTLE LOGGERHEAD	95	2	MAB	A25038	6	720	1	1	0	0
NE	MARINE TURTLE	TURTLE LOGGERHEAD	95	2	MAB	A25038	7	720	1	1	0	0
NE	MARINE TURTLE	TURTLE LEATHERBACK	95	3	MAB	A44040	3	910	1	1	0	0
NE	MARINE TURTLE	TURTLE LOGGERHEAD	95	3	MAB	A44040	9	850	1	1	0	0
NE	MARINE TURTLE	TURTLE LOGGERHEAD	95	3	MAB	A41032	1	800	1	1	0	0
NE	MARINE TURTLE	TURTLE LOGGERHEAD	95	3	MAB	A44043	3	653	2	2	0	0
NE	MARINE TURTLE	TURTLE LOGGERHEAD	95	3	MAB	A44043	4	490	1	1	0	0
NE	MARINE TURTLE	TURTLE LOGGERHEAD	95	3	MAB	A44043	9	840	1	1	0	0
NE	MARINE TURTLE	TURTLE LOGGERHEAD	95	4	MAB	A44048	2	728	1	1	0	0
NE	MARINE TURTLE	TURTLE LOGGERHEAD	95	4	MAB	A44048	12	910	1	1	0	0
NE	MARINE TURTLE	TURTLE LOGGERHEAD	95	4	MAB	A44048	13	910	1	1	0	0
NE	MARINE TURTLE	TURTLE LOGGERHEAD	95	4	NEC	A44051	7	936	1	1	0	0
NE	MARINE TURTLE	TURTLE LOGGERHEAD	95	4	NEC	A44051	10	936	1	1	0	0
NE	MARINE TURTLE	TURTLE LEATHERBACK	95	3	NED	A60038	4	720	1	1	0	0
NE	MARINE TURTLE	TURTLE LEATHERBACK	95	3	NED	A60038	5	900	2	2	0	0
NE	MARINE TURTLE	TURTLE LEATHERBACK	95	3	NED	A60038	6	875	1	1	0	0
NE	MARINE TURTLE	TURTLE LEATHERBACK	95	3	NED	A60038	8	585	1	1	0	0
NE	MARINE TURTLE	TURTLE LEATHERBACK	95	3	NED	A60038	10	810	1	1	0	0
NE	MARINE TURTLE	TURTLE LEATHERBACK	95	3	NED	A60038	11	900	2	2	0	0
NE	MARINE TURTLE	TURTLE LEATHERBACK	95	3	NED	A60038	12	585	1	1	0	0
NE	MARINE TURTLE	TURTLE LEATHERBACK	95	3	NED	A60038	20	720	1	1	0	0
NE	MARINE TURTLE	TURTLE LEATHERBACK	95	3	NED	A53034	4	762	1	1	0	0
NE	MARINE TURTLE	TURTLE LEATHERBACK	95	3	NED	A53034	5	858	4	4	0	0
NE	MARINE TURTLE	TURTLE LEATHERBACK	95	3	NED	A53034	7	822	1	1	0	0
NE	MARINE TURTLE	TURTLE LEATHERBACK	95	3	NED	A53034	8	807	2	2	0	0
NE	MARINE TURTLE	TURTLE LEATHERBACK	95	3	NED	A53034	9	681	3	3	0	0
NE	MARINE TURTLE	TURTLE LEATHERBACK	95	3	NED	A53034	10	855	5	5	0	0
NE	MARINE TURTLE	TURTLE LEATHERBACK	95	3	NED	A53034	11	822	2	2	0	0
NE	MARINE TURTLE	TURTLE LEATHERBACK	95	3	NED	A53034	12	882	1	1	0	0
NE	MARINE TURTLE	TURTLE LEATHERBACK	95	3	NED	A53034	13	861	1	1	0	0
NE	MARINE TURTLE	TURTLE LEATHERBACK	95	3	NED	A53034	14	876	2	2	0	0
NE	MARINE TURTLE	TURTLE LEATHERBACK	95	3	NED	A53034	15	561	1	1	0	0
NE	MARINE TURTLE	TURTLE LEATHERBACK	95	3	NED	A53034	16	840	1	1	0	0
NE	MARINE TURTLE	TURTLE LEATHERBACK	95	3	NED	A53034	17	735	1	1	0	0
NE	MARINE TURTLE	TURTLE LEATHERBACK	95	3	NED	A53034	18	630	2	2	0	0
NE	MARINE TURTLE	TURTLE LOGGERHEAD	95	3	NED	A60038	6	875	1	1	0	0
NE	MARINE TURTLE	TURTLE LOGGERHEAD	95	3	NED	A60038	8	585	2	2	0	0
NE	MARINE TURTLE	TURTLE LOGGERHEAD	95	3	NED	A60038	11	900	1	1	0	0
NE	MARINE TURTLE	TURTLE LOGGERHEAD	95	3	NED	A60038	12	585	4	4	0	0
NE	MARINE TURTLE	TURTLE LOGGERHEAD	95	3	NED	A53034	1	744	2	2	0	0
NE	MARINE TURTLE	TURTLE LOGGERHEAD	95	3	NED	A53034	2	756	2	2	0	0
NE	MARINE TURTLE	TURTLE LOGGERHEAD	95	3	NED	A53034	3	756	2	2	0	0
NE	MARINE TURTLE	TURTLE LOGGERHEAD	95	3	NED	A53034	4	762	2	2	0	0
NE	MARINE TURTLE	TURTLE LOGGERHEAD	95	3	NED	A53034	7	822	3	3	0	0
NE	MARINE TURTLE	TURTLE LOGGERHEAD	95	3	NED	A53034	8	807	2	2	0	0
NE	MARINE TURTLE	TURTLE LOGGERHEAD	95	3	NED	A53034	13	861	1	1	0	0

Table 1. Continued.

NE	MARINE TURTLE	TURTLE LOGGERHEAD	95	3	NED	A53034	17	735	1	1	0	(
NE	MARINE TURTLE	TURTLE LOGGERHEAD	95	3	NED	A53034	18	630	1	1	0	(
NE	MARINE TURTLE	TURTLE LEATHERBACK	95	4	NED	A31049	1	720	1	1	0	(
NE	MARINE TURTLE	TURTLE LEATHERBACK	95	4	NED	A31049	3	756	1	1	0	(
NE	MARINE TURTLE	TURTLE LEATHERBACK	95	4	NED	A31049	5	648	1	1	0	(
NE	MARINE TURTLE	TURTLE LEATHERBACK	95	4	NED	A31049	8	756	3	3	0	(
NE	MARINE TURTLE	TURTLE LEATHERBACK	95	4	NED	A90001	6	810	1	1	0	(
NE	MARINE TURTLE	TURTLE LOGGERHEAD	95	4	NED	A31049	1	720	7	7	0	(
NE	MARINE TURTLE	TURTLE LOGGERHEAD	95	4	NED	A31049	2	720	5	5	0	(
NE	MARINE TURTLE	TURTLE LOGGERHEAD	95	4	NED	A31049	3	756	3	3	0	(
NE	MARINE TURTLE	TURTLE LOGGERHEAD	95	4	NED	A31049	4	756	4	4	0	(
NE	MARINE TURTLE	TURTLE LOGGERHEAD	95	4	NED	A31049	5	648	4	4	0	(
NE	MARINE TURTLE	TURTLE LOGGERHEAD	95	4	NED	A31049	6	540	3	3	0	(
NE	MARINE TURTLE	TURTLE LOGGERHEAD	95	4	NED	A31049	7	450	2	2	0	(
NE	MARINE TURTLE	TURTLE LOGGERHEAD	95	4	NED	A31049	8	756	3	3	0	(
NE	MARINE TURTLE	TURTLE LOGGERHEAD	95	4	NED	A31049	9	756	6	6	0	(
NE	MARINE TURTLE	TURTLE LOGGERHEAD	95	4	NED	A31049	10	756	3	3	0	(
NE	MARINE TURTLE	TURTLE LOGGERHEAD	95	4	NED	A31049	11	720	4	4	0	(
NE	MARINE TURTLE	TURTLE LOGGERHEAD	95	4	NED	A31049	12	540	5	5	0	(
NE	MARINE TURTLE	TURTLE LOGGERHEAD	95	4	NED	A31049	13	612	7	7	0	(
NE	MARINE TURTLE	TURTLE LOGGERHEAD	95	4	NED	A31049	14	648	6	6	0	(
NE	MARINE TURTLE	TURTLE LOGGERHEAD	95	4	NED	A90001	5	812	3	3	0	(
NE	MARINE TURTLE	TURTLE LOGGERHEAD	95	4	NED	A90001	6	810	3	3	0	(
NE	MARINE TURTLE	TURTLE LOGGERHEAD	95	4	NED	A90001	7	896	4	4	0	(
NE	MARINE TURTLE	TURTLE LOGGERHEAD	95	4	NED	A90001	8	810	2	2	0	(
NE	MARINE TURTLE	TURTLE GREEN	95	2	SAB	A32006	9	960	1	1	0	(
SE	MARINE TURTLE	TURTLE	94	1	GOM	Q08	5	900	1	1	0	(
SE	MARINE TURTLE	TURTLE LEATHERBACK	94	1	CAR	J16	4	280	1	1	0	(
SE	MARINE TURTLE	TURTLE LEATHERBACK	94	1	GOM	E02	5	900	2	2	0	(
SE	MARINE TURTLE	TURTLE LEATHERBACK	94	1	GOM	F13	1	931	1	1	0	C
SE	MARINE TURTLE	TURTLE LEATHERBACK	94	1	GOM	F13	3	810	1	1	0	C
SE	MARINE TURTLE	TURTLE LEATHERBACK	94	1	GOM	P07	4	984	1	1	0	C
SE	MARINE TURTLE	TURTLE LEATHERBACK	94	1	GOM	P07	6	984	1	1	0	C
SE	MARINE TURTLE	TURTLE LEATHERBACK	94	1	GOM	P07	8	1000	1	1	0	C
SE	MARINE TURTLE	TURTLE LEATHERBACK	94	1	NCA	M03	11	561	1	1	0	C
SE	MARINE TURTLE	TURTLE LOGGERHEAD	94	1	CAR	J16	4	280	1	1	0	C
SE	MARINE TURTLE	TURTLE LEATHERBACK	94	2	GOM	F14	2	675	1	1	0	C
SE	MARINE TURTLE	TURTLE LEATHERBACK	94	2	GOM	F14	5	645	1	1	0	C
SE	MARINE TURTLE	TURTLE LEATHERBACK	94	2	GOM	F15	3	655	1	1	0	C
SE	MARINE TURTLE	TURTLE LEATHERBACK	94	2	GOM	P10	4	912	1	1	0	C
SE	MARINE TURTLE	TURTLE LEATHERBACK	94	2	MAB	K04	14	690	1	1	0	C
SE	MARINE TURTLE	TURTLE LEATHERBACK	94	3	FEC	B11	1	340	1	1	0	C
SE	MARINE TURTLE	TURTLE LEATHERBACK	94	3	FEC	D04	6	360	1	1	0	C
SE	MARINE TURTLE	TURTLE LEATHERBACK	94	3	GOM	F16	9	760	1	1	0	C
SE	MARINE TURTLE	TURTLE LEATHERBACK	94	4	GOM	F20	1	792	1	1	0	C
SE	MARINE TURTLE	TURTLE	95	1	FEC	T01	1	350	1	1	0	C
SE	MARINE TURTLE	TURTLE	95	1	FEC	T01	5	400	1	1	0	C
SE	MARINE TURTLE	TURTLE LEATHERBACK	95	1	NCA	K06	3	572	1	1	0	0
SE	MARINE TURTLE	TURTLE LEATHERBACK	95	1	NCA	K06	10	572	1	1	0	C
SE	MARINE TURTLE	TURTLE LEATHERBACK	95	1	NCA	L08	5	800	1	1	0	0
SE	MARINE TURTLE	TURTLE LOGGERHEAD	95	1	FEC	T01	4	400	1	1	0	0
SE	MARINE TURTLE	TURTLE LOGGERHEAD	95	1	NCA	K06	6	572	1	1	0	0
SE	MARINE TURTLE	TURTLE LOGGERHEAD	95	1	NCA	M06	10	765	1	1	0	0
SE	MARINE TURTLE	TURTLE LOGGERHEAD	95	1	NCA	M06	19	726	1	1	0	0
SE	MARINE TURTLE	TURTLE	95	2	FEC	T04	2	300	1	1	0	0
SE	MARINE TURTLE	TURTLE	95	2	FEC	T04	3	360	1	1	0	0
SE	MARINE TURTLE	TURTLE LEATHERBACK	95	2	GOM	F24	4	1152	1	1	0	0
SE	MARINE TURTLE	TURTLE LEATHERBACK	95	2	GOM	F25	4	720	1	1	0	0
SE	MARINE TURTLE	TURTLE LEATHERBACK	95	2	GOM	U02	2	1008	1	1	0	0
SE	MARINE TURTLE	TURTLE LEATHERBACK	95	2	GOM	U02	3	1008	1	1	0	0
SE	MARINE TURTLE	TURTLE LEATHERBACK	95	2	NCA	N06	12	798	2	2	0	0
SE	MARINE TURTLE	TURTLE LEATHERBACK	95	2	NCA	N06	14	798	1	1	0	0
SE	MARINE TURTLE	TURTLE LEATHERBACK	95	2	SAB	K07	4	372	1	1	0	0
SE	MARINE TURTLE	TURTLE LEATHERBACK	95	2	SAB	M07	6	770	1	1	0	0
SE	MARINE TURTLE	TURTLE LOGGERHEAD	95	2	SAB	K07	8	389	1	1	0	0
SE	MARINE TURTLE	TURTLE LOGGERHEAD	95	2	SAB	T02	7	252	1	1	0	0
SE	MARINE TURTLE	TURTLE GREEN	95	3	FEC	T10	1	470	1	1	0	0
SE	MARINE TURTLE	TURTLE LEATHERBACK	95	3	MAB	K08	3	875	1	1	0	0
SE	MARINE TURTLE	TURTLE LOGGERHEAD	95	3	MAB	K08	1	840	1	1	0	0
SE	MARINE TURTLE	TURTLE LOGGERHEAD	95	3	MAB	K08	2	825	2	2	0	0
SE	MARINE TURTLE	TURTLE LOGGERHEAD	95	3	MAB	K08	6	735	1	1	0	0
SE	MARINE TURTLE	TURTLE LEATHERBACK	95	4	GOM	K10	2	793	1	1	0	0

Table 2. Observed sets (AQSETS) and hooks set (AQHOOK) plus logbook reported sets (LOGSETS) and hooks set (LOGHOOK) for pelagic longline vessels used in the analysis by year (YR, 1994-1995), claendar quarter (QUARTR), and fishing region (NAREA).

YR	NAREA	QUARTR	AQHOOK	AQSETS	LOGHOOK	LOGSETS	YR	NAREA	QUARTR	AQHOOK	AQSETS	LOGHOOK	LOGSET
94	CAR	1	14922	35	213180	462	95	CAR	1	9747	23	265109	614
94	GOM	1	22690	25	434906	655	95	CAR	2	5346	12	123633	260
94	GOM	2	23629	33	593749	802	95	CAR	3	5974	12	87125	206
94	GOM	3	33682	49	573419	771	95	CAR	4	350	1	17441	41
94	GOM	4	33572	47	482822	656	95	GOM	1	36925	44	512911	753
94	NEC	1	18675	26	96085	138	95	GOM	2	54331	66	537041	767
94	NEC	2	59123	72	233014	355	95	GOM	3	38351	47	621013	875
94	NEC	3	141132	198	1145155	1618	95	GOM	4	38702	54	441482	608
94	NEC	4	100796	148	829142	1110	95	NEC	1	27629	42	94582	139
94	NED	3	17128	18	456973	577	95	NEC	2	11860	21	377391	514
94	NED	4	39471	43	263272	346	95	NEC	3	118392	169	1378571	1785
94	OFS	1	11951	19	224426	388	95	NEC	4	82704	100	918746	1211
94	SEC	1	11373	27	278678	697	95	NED	3	29715	39	542732	700
94	SEC	2	17518	42	477837	1268	95	NED	4	19047	26	161535	196
94	SEC	3	16411	49	240708	792	95	OFS	1	50278	71	565262	803
94	SEC	4	4568	20	185045	596	95	OFS	2	17501	22	368735	518
							95	SEC	1	2921	8	253944	614
							95	SEC	2	21774	45	528511	1119
							95	SEC	3	5712	12	188939	538
							95	SEC	4	4197	12	146776	452

Table 3. Quarterly (QUARTR, for years, YR, 1994-1995) estimates total catch (CATCH), of animals dead upon return to the sea (CDEAD), and of animals alive upon return to the sea (CALIVE) as classified by observers. Also indicated are estimated coefficients of variation for the catch estimates (CV_C, CV_D, CV_A for total, dead, and alive catches, respectively) and upper and lower 95% lognormal confidence bounds (UCAT, LCAT for total catch; UDED, LDED for dead animals; and ULIVE, LLIVE for living animals). These estimates are provided for the fishing regions (NAREA) in which catch of these species was observed. Also indicated are the number of sets observed in the area-year-quarter stratum (N), the number of sets on which at least one animal o the species group indicated was observed caught (MC) and the ratio (MC/N = PPC, proportion of observed sets where a capture occurred).

-- GROUP=MARINE MAMMAL --

COMMON	NAREA	YR	QUARTR	N	MC	PPC	CATCH	CV_CC	UCAT	LCAT	CDEAD	CV_CD	UDED	LDED	CALIVE	CV_CA	ULIVE	LLIVE
DOLPHIN ATLANTIC SPOTTED	GOM	94	3	49	1	0.02	14	1.00	72	3	0	.	.	.	14	1.00	72	3
DOLPHIN PANTROPIC SPOTTED	GOM	94	2	33	1	0.03	26	1.00	133	5	0	.	.	.	26	1.00	133	5
DOLPHIN RISSOS	NEC	94	3	198	3	0.02	23	0.58	66	8	7	1	36	1	16	0.71	56	5
DOLPHIN RISSOS	NEC	94	4	148	3	0.02	26	0.57	74	9	0	.	.	.	26	0.57	74	9
DOLPHIN RISSOS	NEC	95	3	169	4	0.02	47	0.51	121	18	0	.	.	.	47	0.51	121	18
KILLER WHALE	NED	94	4	43	1	0.02	6	1.00	31	1	0	.	.	.	6	1.00	31	1
MARINE MAMMAL	NEC	95	3	169	1	0.01	13	1.00	66	3	0	.	.	.	13	1.00	66	3
PILOT WHALE	NEC	94	1	26	1	0.04	4	1.00	20	1	0	.	.	.	0	.	.	.
PILOT WHALE	NEC	94	3	198	6	0.03	46	0.41	99	21	0	.	.	.	46	0.41	99	21
PILOT WHALE	NEC	94	4	148	1	0.01	9	1.00	46	2	0	.	.	.	9	1.00	46	2
PILOT WHALE	NEC	95	3	169	8	0.05	97	0.35	190	49	0	.	.	.	97	0.35	190	49
PILOT WHALE	NEC	95	4	100	3	0.03	37	0.60	110	12	0	.	.	.	37	0.60	110	12
PILOT WHALE	NED	95	3	39	1	0.03	25	1.00	128	5	0	.	.	.	25	1.00	128	5
PILOT WHALE	SEC	94	3	49	2	0.04	46	0.75	171	12	0	.	.	.	46	0.75	171	12
PILOT WHALE	SEC	95	4	12	1	0.08	34	1.00	174	7	0	.	.	.	34	1.00	174	7
SHORTFIN PILOT WHALE	NEC	95	3	169	1	0.01	17	1.00	87	3	0	.	.	.	17	1.00	87	3

-- GROUP=MARINE TURTLE --

COMMON	NAREA	YR	QUARTR	N	MC	PPC	CATCH	CV_CC	UCAT	LCAT	CDEAD	CV_CD	UDED	LDED	CALIVE	CV_CA	ULIVE	LLIVE
TURTLE	GOM	94	1	25	1	0.04	19	1.00	97	4	0	.	.	.	19	1.00	97	4
TURTLE	NED	94	3	18	1	0.06	26	1.00	133	5	0	.	.	.	26	1.00	133	5
TURTLE	SEC	95	1	8	2	0.25	170	0.66	550	53	0	.	.	.	170	0.66	550	53
TURTLE	SEC	95	2	45	2	0.04	72	0.70	249	21	0	.	.	.	72	0.70	249	21
TURTLE GREEN	NEC	94	2	72	2	0.03	10	0.75	37	3	0	.	.	.	10	0.75	37	3
TURTLE GREEN	NEC	94	3	198	1	0.01	10	1.00	51	2	0	.	.	.	10	1.00	51	2
TURTLE GREEN	NEC	95	2	21	1	0.05	19	1.00	97	4	0	.	.	.	19	1.00	97	4
TURTLE GREEN	NED	94	3	18	1	0.06	26	1.00	133	5	0	.	.	.	26	1.00	133	5
TURTLE GREEN	SEC	95	2	45	1	0.02	12	1.00	61	2	0	.	.	.	12	1.00	61	2
TURTLE GREEN	SEC	95	3	12	1	0.08	33	1.00	169	6	0	.	.	.	33	1.00	169	6
TURTLE KEMPS RIDLEY	NEC	94	3	198	1	0.01	10	1.00	51	2	0	.	.	.	10	1.00	51	2
TURTLE LEATHERBACK	CAR	94	1	35	1	0.03	22	1.00	112	4	0	.	.	.	22	1.00	112	4
TURTLE LEATHERBACK	GOM	94	1	25	6	0.24	131	0.38	270	64	0	.	.	.	131	0.38	270	64
TURTLE LEATHERBACK	GOM	94	2	33	4	0.12	102	0.48	250	42	0	.	.	.	102	0.48	250	42
TURTLE LEATHERBACK	GOM	94	3	49	1	0.02	15	1.00	77	3	0	.	.	.	15	1.00	77	3
TURTLE LEATHERBACK	GOM	94	4	47	1	0.02	13	1.00	66	3	0	.	.	.	13	1.00	66	3

Table 2. Observed sets (AQSETS) and hooks set (AQHOOK) plus logbook reported sets (LOGSETS) and hooks set (LOGHOOK) for pelagic longline vessels used in the analysis by year (YR, 1994-1995), claendar quarter (QUARTR), and fishing region (NAREA).

YR	NAREA	QUARTR	AQHOOK	AQSETS	LOGHOOK	LOGSETS
94	CAR	1	14922	35	213180	462
94	GOM	1	22690	25	434906	655
94	GOM	2	23629	33	593749	802
94	GOM	3	33682	49	573419	771
94	GOM	4	33572	47	482822	656
94	NEC	1	18675	26	96085	138
94	NEC	2	59123	72	233014	355
94	NEC	3	141132	198	1145155	1618
94	NEC	4	100796	148	829142	1110
94	NED	3	17128	18	456973	577
94	NED	4	39471	43	263272	346
94	OFS	1	11951	19	224426	388
94	SEC	1	11373	27	278678	697
94	SEC	2	17518	42	477837	1268
94	SEC	3	16411	49	240708	792
94	SEC	4	4568	20	185045	596

YR	NAREA	QUARTR	AQHOOK	AQSETS	LOGHOOK	LOGSE
95	CAR	1	9747	23	265109	61
95	CAR	2	5346	12	123633	26
95	CAR	3	5974	12	87125	20
95	CAR	4	350	1	17441	4
95	GOM	1	36925	44	512911	75
95	GOM	2	54331	66	537041	76
95	GOM	3	38351	47	621013	87
95	GOM	4	38702	54	441482	60
95	NEC	1	27629	42	94582	13
95	NEC	2	11860	21	377391	51
95	NEC	3	118392	169	1378571	178
95	NEC	4	82704	100	918746	121
95	NED	3	29715	39	542732	70
95	NED	4	19047	26	161535	19
95	OFS	1	50278	71	565262	80
95	OFS	2	17501	22	368735	51
95	SEC	1	2921	8	253944	61
95	SEC	2	21774	45	528511	111
95	SEC	3	5712	12	188939	53
95	SEC	4	4197	12	146776	45

Table 3. Quarterly (QUARTR, for years, YR, 1994-1995) estimates total catch (CATCH), of animals dead upon return to the sea (CDEAD), and of animals alive upon return to the sea (CALIVE) as classified by observers. Also indicated are estimated coefficients of variation for the catch estimates (CV_C, CV_D, CV_A for total, dead, and alive catches, respectively) and upper and lower 95% lognormal confidence bounds (UCAT, LCAT for total catch; UDED, LDED for dead animals; and ULIVE, LLIVE for living animals). These estimates are provided for the fishing regions (NAREA) in which catch of these species was observed. Also indicated are the number of sets observed in the area-year-quarter stratum (N), the number of sets on which at least one animal the species group indicated was observed caught (MC) and the ratio (MC/N = PPC, proportion of observed sets where a capture occurred).

-- GROUP=MARINE MAMMAL --

COMMON	NAREA	YR	QUARTR	N	MC	PPC	CATCH	CV_CC	UCAT	LCAT	CDEAD	CV_CD	UDED	LDED	CALIVE	CV_CA	ULIVE	LLIVE
DOLPHIN ATLANTIC SPOTTED	GOM	94	3	49	1	0.02	14	1.00	72	3	0	.	.	.	14	1.00	72	3
DOLPHIN PANTROPIC SPOTTED	GOM	94	2	33	1	0.03	26	1.00	133	5	0	.	.	.	26	1.00	133	5
DOLPHIN RISSOS	NEC	94	3	198	3	0.02	23	0.58	66	8	7	1	36	1	16	0.71	56	5
DOLPHIN RISSOS	NEC	94	4	148	3	0.02	26	0.57	74	9	0	.	.	.	26	0.57	74	9
DOLPHIN RISSOS	NEC	95	3	169	4	0.02	47	0.51	121	18	0	.	.	.	47	0.51	121	18
KILLER WHALE	NED	94	4	43	1	0.02	6	1.00	31	1	0	.	.	.	6	1.00	31	1
MARINE MAMMAL	NEC	95	3	169	1	0.01	13	1.00	66	3	0	.	.	.	13	1.00	66	3
PILOT WHALE	NEC	94	1	26	1	0.04	4	1.00	20	1	0	.	.	.	0	.	.	.
PILOT WHALE	NEC	94	3	198	6	0.03	46	0.41	99	21	0	.	.	.	46	0.41	99	21
PILOT WHALE	NEC	94	4	148	1	0.01	9	1.00	46	2	0	.	.	.	9	1.00	46	2
PILOT WHALE	NEC	95	3	169	8	0.05	97	0.35	190	49	0	.	.	.	97	0.35	190	49
PILOT WHALE	NEC	95	4	100	3	0.03	37	0.60	110	12	0	.	.	.	37	0.60	110	12
PILOT WHALE	NED	95	3	39	1	0.03	25	1.00	128	5	0	.	.	.	25	1.00	128	5
PILOT WHALE	SEC	94	3	49	2	0.04	46	0.75	171	12	0	.	.	.	46	0.75	171	12
PILOT WHALE	SEC	95	4	12	1	0.08	34	1.00	174	7	0	.	.	.	34	1.00	174	7
SHORTFIN PILOT WHALE	NEC	95	3	169	1	0.01	17	1.00	87	3	0	.	.	.	17	1.00	87	3

-- GROUP=MARINE TURTLE --

COMMON	NAREA	YR	QUARTR	N	MC	PPC	CATCH	CV_CC	UCAT	LCAT	CDEAD	CV_CD	UDED	LDED	CALIVE	CV_CA	ULIVE	LLIVE
TURTLE	GOM	94	1	25	1	0.04	19	1.00	97	4	0	.	.	.	19	1.00	97	4
TURTLE	NED	94	3	18	1	0.06	26	1.00	133	5	0	.	.	.	26	1.00	133	5
TURTLE	SEC	95	1	8	2	0.25	170	0.66	550	53	0	.	.	.	170	0.66	550	53
TURTLE	SEC	95	2	45	2	0.04	72	0.70	249	21	0	.	.	.	72	0.70	249	21
TURTLE GREEN	NEC	94	2	72	2	0.03	10	0.75	37	3	0	.	.	.	10	0.75	37	3
TURTLE GREEN	NEC	94	3	198	1	0.01	10	1.00	51	2	0	.	.	.	10	1.00	51	2
TURTLE GREEN	NEC	95	2	21	1	0.05	19	1.00	97	4	0	.	.	.	19	1.00	97	4
TURTLE GREEN	NED	94	3	18	1	0.06	26	1.00	133	5	0	.	.	.	26	1.00	133	5
TURTLE GREEN	SEC	95	2	45	1	0.02	12	1.00	61	2	0	.	.	.	12	1.00	61	2
TURTLE GREEN	SEC	95	3	12	1	0.08	33	1.00	169	6	0	.	.	.	33	1.00	169	6
TURTLE KEMPS RIDLEY	NEC	94	3	198	1	0.01	10	1.00	51	2	0	.	.	.	10	1.00	51	2
TURTLE LEATHERBACK	CAR	94	1	35	1	0.03	22	1.00	112	4	0	.	.	.	22	1.00	112	4
TURTLE LEATHERBACK	GOM	94	1	25	6	0.24	131	0.38	270	64	0	.	.	.	131	0.38	270	64
TURTLE LEATHERBACK	GOM	94	2	33	4	0.12	102	0.48	250	42	0	.	.	.	102	0.48	250	42
TURTLE LEATHERBACK	GOM	94	3	49	1	0.02	15	1.00	77	3	0	.	.	.	15	1.00	77	3
TURTLE LEATHERBACK	GOM	94	4	47	1	0.02	13	1.00	66	3	0	.	.	.	13	1.00	66	3

TURTLE LEATHERBACK	GOM	95	2	66	4	0.06	34	0.50	85	14	0	.	.	.	34	0.50	85	14
TURTLE LEATHERBACK	GOM	95	4	54	1	0.02	10	1.00	51	2	0	.	.	.	10	1.00	51	2
TURTLE LEATHERBACK	NEC	94	2	72	1	0.01	5	1.00	26	1	0	.	.	.	5	1.00	26	1
TURTLE LEATHERBACK	NEC	94	3	198	5	0.03	45	0.45	104	20	0	.	.	.	45	0.45	104	20
TURTLE LEATHERBACK	NEC	94	4	148	3	0.02	35	0.63	108	11	0	.	.	.	35	0.63	108	11
TURTLE LEATHERBACK	NEC	95	1	42	1	0.02	2	1.00	10	0	0	.	.	.	2	1.00	10	0
TURTLE LEATHERBACK	NEC	95	2	21	1	0.05	30	1.00	153	6	0	.	.	.	30	1.00	153	6
TURTLE LEATHERBACK	NEC	95	3	169	2	0.01	18	0.71	63	5	0	.	.	.	18	0.71	63	5
TURTLE LEATHERBACK	NED	94	3	18	1	0.06	26	1.00	133	5	0	.	.	.	26	1.00	133	5
TURTLE LEATHERBACK	NED	94	4	43	10	0.23	85	0.31	155	47	0	.	.	.	85	0.31	155	47
TURTLE LEATHERBACK	NED	95	3	39	22	0.56	650	0.18	920	459	0	.	.	.	650	0.18	920	459
TURTLE LEATHERBACK	NED	95	4	26	5	0.19	58	0.45	136	25	0	.	.	.	58	0.45	136	25
TURTLE LEATHERBACK	OFS	94	1	19	1	0.05	21	1.00	107	4	0	.	.	.	21	1.00	107	4
TURTLE LEATHERBACK	OFS	95	1	71	3	0.04	38	0.58	109	13	0	.	.	.	38	0.58	109	13
TURTLE LEATHERBACK	OFS	95	2	22	2	0.09	63	0.73	227	17	0	.	.	.	63	0.73	227	17
TURTLE LEATHERBACK	SEC	94	3	49	2	0.04	28	0.70	97	8	0	.	.	.	28	0.70	97	8
TURTLE LEATHERBACK	SEC	95	2	45	2	0.04	47	0.74	172	13	0	.	.	.	47	0.74	172	13
TURTLE LOGGERHEAD	CAR	94	1	35	1	0.03	22	1.00	112	4	0	.	.	.	22	1.00	112	4
TURTLE LOGGERHEAD	NEC	94	3	198	1	0.01	7	1.00	36	1	0	.	.	.	7	1.00	36	1
TURTLE LOGGERHEAD	NEC	94	4	148	2	0.01	16	0.71	56	5	7	1	36	1	8	1.00	41	2
TURTLE LOGGERHEAD	NEC	95	2	21	4	0.19	124	0.49	306	50	0	.	.	.	124	0.49	306	50
TURTLE LOGGERHEAD	NEC	95	3	169	8	0.05	111	0.37	223	55	0	.	.	.	111	0.37	223	55
TURTLE LOGGERHEAD	NEC	95	4	100	5	0.05	52	0.44	119	23	0	.	.	.	52	0.44	119	23
TURTLE LOGGERHEAD	NED	94	3	18	16	0.89	1091	0.21	1648	722	0	.	.	.	1091	0.21	1648	722
TURTLE LOGGERHEAD	NED	94	4	43	17	0.40	273	0.26	452	165	0	.	.	.	273	0.26	452	165
TURTLE LOGGERHEAD	NED	95	3	39	13	0.33	461	0.27	782	272	0	.	.	.	461	0.27	782	272
TURTLE LOGGERHEAD	NED	95	4	26	18	0.69	669	0.17	925	484	0	.	.	.	669	0.17	925	484
TURTLE LOGGERHEAD	OFS	95	1	71	3	0.04	35	0.57	100	12	0	.	.	.	35	0.57	100	12
TURTLE LOGGERHEAD	SEC	95	1	8	1	0.13	79	1.00	404	15	0	.	.	.	79	1.00	404	15
TURTLE LOGGERHEAD	SEC	95	2	45	2	0.04	77	0.72	272	22	0	.	.	.	77	0.72	272	22

Table 4. Annual (YR, 1994-1995) estimates of total catch (CATCH), of animals dead upon return to the sea (CDEAD), and of animals alive upon return to the sea (CALIVE) as classified by observers. Also indicated are estimated coefficients of variation for the catch estimates (CV_C, CV_D, CV_A for total, dead, and alive catches, respectively) and upper and lower 95% lognormal confidence bounds (UCAT, LCAT for total catch; UDED, LDED for dead animals; and ULIVE, LLIVE for living animals). These estimates are provided for the fishing regions (NAREA) in which catch of these species was observed. The estimates here represent a summation (the stratum-wise estimates in Table 3. In some cases, considerable gains in precision about the estimates could be attained through pooling across strata.

GROUP=MARINE MAMMAL

COMMON	NAREA	YR	CATCH	CV_C	UCAT	LCAT	CDEAD	CV_D	UDED	LDED	CALIVE	CV_A	ULIVE	LLIV
DOLPHIN ATLANTIC SPOTTED	GOM	94	14	1.00	72	3	0	.	.	.	14	1.00	72	3
DOLPHIN PANTROPIC SPOTTED	GOM	94	26	1.00	133	5	0	.	.	.	26	1.00	133	5
DOLPHIN RISSOS	NEC	94	49	0.58	140	17	7	1	36	1	42	0.63	130	14
DOLPHIN RISSOS	NEC	95	47	0.51	121	18	0	.	.	.	47	0.51	121	18
KILLER WHALE	NED	94	6	1.01	31	1	0	.	.	.	6	1.01	31	1
MARINE MAMMAL	NEC	95	13	0.99	66	3	0	.	.	.	13	0.99	66	3
PILOT WHALE	NEC	94	59	0.56	165	24	0	.	.	.	55	0.53	145	23
PILOT WHALE	NEC	95	134	0.43	300	61	0	.	.	.	134	0.43	300	61
PILOT WHALE	NED	95	25	1.00	128	5	0	.	.	.	25	1.00	128	5
PILOT WHALE	SEC	94	46	0.75	171	12	0	.	.	.	46	0.75	171	12
PILOT WHALE	SEC	95	34	1.00	174	7	0	.	.	.	34	1.00	174	7
SHORTFIN PILOT WHALE	NEC	95	17	1.00	87	3	0	.	.	.	17	1.00	87	3

GROUP=MARINE TURTLE

COMMON	NAREA	YR	CATCH	CV_C	UCAT	LCAT	CDEAD	CV_D	UDED	LDED	CALIVE	CV_A	ULIVE	LLIVE
TURTLE	GOM	94	19	1.00	97	4	0	.	.	.	19	1.00	97	4
TURTLE	NED	94	26	1.00	133	5	0	.	.	.	26	1.00	133	5
TURTLE	SEC	95	242	0.67	799	74	0	.	.	.	242	0.67	799	74
TURTLE GREEN	NEC	94	20	0.88	88	5	0	.	.	.	20	0.88	88	5
TURTLE GREEN	NEC	95	19	1.00	97	4	0	.	.	.	19	1.00	97	4
TURTLE GREEN	NED	94	26	1.00	133	5	0	.	.	.	26	1.00	133	5
TURTLE GREEN	SEC	95	45	1.00	230	8	0	.	.	.	45	1.00	230	8
TURTLE KEMPS RIDLEY	NEC	94	10	1.00	51	2	0	.	.	.	10	1.00	51	2
TURTLE LEATHERBACK	CAR	94	22	1.00	112	4	0	.	.	.	22	1.00	112	4
TURTLE LEATHERBACK	GOM	94	261	0.50	663	112	0	.	.	.	261	0.50	663	112
TURTLE LEATHERBACK	GOM	95	44	0.63	136	16	0	.	.	.	44	0.63	136	16
TURTLE LEATHERBACK	NEC	94	85	0.56	238	32	0	.	.	.	85	0.56	238	32
TURTLE LEATHERBACK	NEC	95	50	0.90	226	11	0	.	.	.	50	0.90	226	11
TURTLE LEATHERBACK	NED	94	111	0.52	288	52	0	.	.	.	111	0.52	288	52
TURTLE LEATHERBACK	NED	95	708	0.21	1056	484	0	.	.	.	708	0.21	1056	484
TURTLE LEATHERBACK	OFS	94	21	1.00	107	4	0	.	.	.	21	1.00	107	4
TURTLE LEATHERBACK	OFS	95	101	0.68	336	30	0	.	.	.	101	0.68	336	30
TURTLE LEATHERBACK	SEC	94	28	0.70	97	8	0	.	.	.	28	0.70	97	8
TURTLE LEATHERBACK	SEC	95	47	0.74	172	13	0	.	.	.	47	0.74	172	13
TURTLE LOGGERHEAD	CAR	94	22	1.00	112	4	0	.	.	.	22	1.00	112	4
TURTLE LOGGERHEAD	NEC	94	23	0.81	92	6	7	1	36	1	15	1.00	77	3

TURTLE LOGGERHEAD	NEC	95	287	0.43	648	128	0	.	.	.	287	0.43	648	128
TURTLE LOGGERHEAD	NED	94	1364	0.22	2100	887	0	.	.	.	1364	0.22	2100	887
TURTLE LOGGERHEAD	NED	95	1130	0.21	1707	756	0	.	.	.	1130	0.21	1707	756
TURTLE LOGGERHEAD	OFS	95	35	0.58	100	12	0	.	.	.	35	0.58	100	12
TURTLE LOGGERHEAD	SEC	95	156	0.87	676	37	0	.	.	.	156	0.87	676	37

Table 5. Annual (YR, 1994-1995) estimates of total catch (CATCH), of animals dead upon return to the sea (CDEAD), and of animals alive upon return to the sea (CALIVE) as classified by observers. Also indicated are estimated coefficients of variation for the catch estimates (CV_C, CV_D, CV_A for total, dead, and alive catches, respectively) and upper and lower 95% lognormal confidence bounds (UCAT, LCAT for total catch; UDED, LDED for dead animals; and ULIVE, LLIVE for living animals). These estimates are provided for large ocean areas (MAREA) which generally correspond to Atlantic waters within (US Atl) or outside (OthAtl) of the EEZ. Gulf of Mexico (GOM) estimates, however, are as indicated above and can result from effort both within and outside of the U EEZ in the Gulf of Mexico. The estimates here represent a summation of the stratum-wise estimates in Table 3. In some cases, considerable gains in precision about the estimates could be attained through pooling across strata.

GROUP=MARINE MAMMAL

COMMON	MAREA	YR	CATCH	CV_C	UCAT	LCAT	CDEAD	CV_D	UDED	LDED	CALIVE	CV_A	ULIVE	LLI
DOLPHIN ATLANTIC SPOTTED	GOM	94	14	1.00	72	3	0	.	.	.	14	1.00	72	
DOLPHIN PANTROPIC SPOTTED	GOM	94	26	1.00	133	5	0	.	.	.	26	1.00	133	
DOLPHIN RISSOS	US Atl	94	49	0.58	140	17	7	1	36	1	42	0.63	130	1
DOLPHIN RISSOS	US Atl	95	47	0.51	121	18	0	.	.	.	47	0.51	121	1
KILLER WHALE	OthAtl	94	6	1.01	31	1	0	.	.	.	6	1.01	31	
MARINE MAMMAL	US Atl	95	13	0.99	66	3	0	.	.	.	13	0.99	66	
PILOT WHALE	OthAtl	95	25	1.00	128	5	0	.	.	.	25	1.00	128	
PILOT WHALE	US Atl	94	105	0.65	336	36	0	.	.	.	101	0.63	316	3
PILOT WHALE	US Atl	95	168	0.57	474	68	0	.	.	.	168	0.57	474	6
SHORTFIN PILOT WHALE	US Atl	95	17	1.00	87	3	0	.	.	.	17	1.00	87	

GROUP=MARINE TURTLE

COMMON	MAREA	YR	CATCH	CV_C	UCAT	LCAT	CDEAD	CV_D	UDED	LDED	CALIVE	CV_A	ULIVE	LLIVE
TURTLE	GOM	94	19	1.00	97	4	0	.	.	.	19	1.00	97	4
TURTLE	OthAtl	94	26	1.00	133	5	0	.	.	.	26	1.00	133	5
TURTLE	US Atl	95	242	0.67	799	74	0	.	.	.	242	0.67	799	74
TURTLE GREEN	OthAtl	94	26	1.00	133	5	0	.	.	.	26	1.00	133	5
TURTLE GREEN	US Atl	94	20	0.88	88	5	0	.	.	.	20	0.88	88	5
TURTLE GREEN	US Atl	95	64	1.00	327	12	0	.	.	.	64	1.00	327	12
TURTLE KEMPS RIDLEY	US Atl	94	10	1.00	51	2	0	.	.	.	10	1.00	51	2
TURTLE LEATHERBACK	GOM	94	261	0.50	663	112	0	.	.	.	261	0.50	663	112
TURTLE LEATHERBACK	GOM	95	44	0.63	136	16	0	.	.	.	44	0.63	136	16
TURTLE LEATHERBACK	OthAtl	94	154	0.67	507	60	0	.	.	.	154	0.67	507	60
TURTLE LEATHERBACK	OthAtl	95	809	0.28	1392	514	0	.	.	.	809	0.28	1392	514
TURTLE LEATHERBACK	US Atl	94	113	0.60	335	40	0	.	.	.	113	0.60	335	40
TURTLE LEATHERBACK	US Atl	95	97	0.82	398	24	0	.	.	.	97	0.82	398	24
TURTLE LOGGERHEAD	OthAtl	94	1386	0.24	2212	891	0	.	.	.	1386	0.24	2212	891
TURTLE LOGGERHEAD	OthAtl	95	1165	0.23	1807	768	0	.	.	.	1165	0.23	1807	768
TURTLE LOGGERHEAD	US Atl	94	23	0.81	92	6	7	1	36	1	15	1.00	77	3
TURTLE LOGGERHEAD	US Atl	95	443	0.61	1324	165	0	.	.	.	443	0.61	1324	165

Table 6. Annual (1994-1995) estimates of marine mammal and marine turtle catch by large areas of the ocean. Estimates are based pooled samples across the regions defined (MAREA) and for the species groupings shown. Substantial gains in precision of the estimates are obtained (see for comparison, Table 5 above). No listing for an area and year implies an estimate of 0. Other variables as indicated in Table 5.

a: Annual Effort Statistics (see Table 2 for variable definitions).

YR	MAREA	AQHOOK	AQSETS	LOGHOOK	LOGSETS
94	GOM	113573	154	2084896	2884
94	OthAtl	83472	115	1791207	2904
94	US Atl	369596	582	3485664	6574

YR	MAREA	AQHOOK	AQSETS	LOGHOOK	LOGSETS
95	GOM	168309	211	2112447	3003
95	OthAtl	137958	206	2199540	3438
95	US Atl	275189	409	3887460	6372

b: Annual Species Group Estimates:

GROUP=MARINE MAMMAL

MAREA	YR	CATCH	CV_C	UCAT	LCAT	CDEAD	CV_D	UDED	LDED	CALIVE	CV_A	ULIVE	LLIVE
GOM	94	36	0.70	125	10	0	.	.	.	36	0.70	125	10
OthAtl	94	16	1.00	82	3	0	.	.	.	16	1.00	82	3
US Atl	94	165	0.27	277	98	7	1	36	1	152	0.29	265	87
OthAtl	95	19	1.00	97	4	0	.	.	.	19	1.00	97	4
US Atl	95	267	0.24	425	168	0	.	.	.	267	0.24	425	168

GROUP=MARINE TURTLE

MAREA	YR	CATCH	CV_C	UCAT	LCAT	CDEAD	CV_D	UDED	LDED	CALIVE	CV_A	ULIVE	LLIVE
GOM	94	228	0.27	386	135	0	.	.	.	228	0.27	386	135
OthAtl	94	1750	0.15	2345	1306	0	.	.	.	1750	0.15	2345	1306
US Atl	94	188	0.25	302	117	8	1	41	2	180	0.25	293	111
GOM	95	55	0.45	128	24	0	.	.	.	55	0.45	128	24
OthAtl	95	2218	0.13	2885	1705	0	.	.	.	2218	0.13	2885	1705
US Atl	95	568	0.18	811	398	0	.	.	.	568	0.18	811	398

Table 7. Analysis of Variance results for the loglinear model Loge(CV) = b0 + b1(BIN) + b2(SFS) + e. The variable CV is the stratum-wise (year-narea-quarter coefficient of variation for the estimated catch for the species obsrved cautht by US pelagic longlined vessels operating in the Atlantic during 1992-1995. The variable BIN represents 5%-tile categories of the proportion positive sets observed for each species category in the year-area-quarter strata (see variable PPC in Table 3). The variable SFS is the sampling fraction per year-area-quarter stratum expressed as sets observed divided by sets reported in logbooks. In this analysis, the sampling fraction is treated as a continuous variable and is used with the proportion positive information to predict the expected CV shown in Figure 8. Parameter estimates for the model predictions of Log_e(CV) are also shown.

Dependent Variable: Log_e(CV)

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	11	484.15561723	44.01414702	460.65	0.0001
Error	2121	202.65507614	0.09554695		
Corrected Total	2132	686.81069337			

R-Square	C.V.	Root MSE	Log_e(CV) Mean
0.704933	-48.39776	0.3091067	-0.6386797

Source	DF	Type III SS	Mean Square	F Value	Pr > F
BIN	10	483.11449988	48.31144999	505.63	0.0001
SFS	1	13.10697989	13.10697989	137.18	0.0001

Parameter		Estimate		T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT		-1.433462596	b0	-71.00	0.0001	0.02019090
Proportion Positive BIN	<5%	1.392929937	b1,0	61.41	0.0001	0.02268130
	5-9%	1.058299684	b1,1	42.81	0.0001	0.02472353
	10-14%	0.873467595	b1,2	30.03	0.0001	0.02908714
	15-19%	0.686289172	b1,3	20.42	0.0001	0.03361196
	20-24%	0.537127553	b1,4	14.20	0.0001	0.03783490
	25-29%	0.545867622	b1,5	14.55	0.0001	0.03751884
	30-34%	0.406870582	b1,6	10.34	0.0001	0.03935777
	35-39%	0.316787634	b1,7	6.80	0.0001	0.04660320
	40-44%	0.222276535	b1,8	4.41	0.0001	0.05042433
	45-49%	0.197345603	b1,9	3.21	0.0014	0.06156487
	>=50%	0.000000000	b1,10	.	.	.
SFS		-1.225805982	b2	-11.71	0.0001	0.10465954

Table 8. Observer comments relating to condition of marine mammals observed caught in 1994-1995 by US pelagic longline vessels operating in the Atlantic.

Trip #	Date	Species	Lat	Lon	Comments
A02	1/8/94	Pilot whale	37 15	74 20	alive; cut from gear; condition unknown
A28030	8/9/94	Pilot whale	39 01	72 41	alive; mainline wrapped around fluke; one end of linecut and the other pulled free animal; animal swam away
	8/16/94	Pilot whale	38 55	72 51	hooked in pectoral fin; gangion cut and animal swam away
A32006	8/11/94	Pilot whale	37 15	74 29	alive; gangion cut; animal swam away
	8/11/94	Pilot whale	37 15	74 29	same as previous entry
	8/11/94	Pilot whale	37 15	74 29	same as previous entry
	8/11/94	Pilot whale	37 15	74 29	same as previous entry
	8/11/94	Pilot whale	37 15	74 29	same as previous entry
	8/12/94	Pilot whale	37 20	74 20	tangled in mainline; cut free; swam away
A32008	8/26/94	Grampus	38 45	72 54	dead; animal wrapped in gear; mainline wrapped around body immediately adjac to flukes
A44004	9/16/94	Pilot whale	38 24	73 24	alive; hooked in dorsal fin; mainline cut to releaseanimal with gangion still attached
	9/17/94	Pilot whale	38 16	73 30	animal cut from mainline several wraps of mainline and part of gangion around base of flukes/tail; animal swam off slowly
	9/18/94	Grampus	38 02	73 17	hooked in mouth; broke gangion from mainline; released alive
	9/19/94	Pilot whale	37 50	73 19	hooked in mouth; broke gangion from mainline; swam away strongly trailin 50 fathoms of mainline from its mouth
	9/21/94	Grampus	39 52	70 02	hooked in tail fluke and mainline; gear cut to release animal; swam away with mainline and leader around tail
A53037-	9/21/94	Grampus	39 55	69 20	alive; gear wrapped around animal; cut loose by crew; swam away quickly
A54003-	9/21/94	Killer whale	47 24	40 48	alive
A62002	10/21/94	Grampus	39 48	69 59	a good amount of mainline was tangled around animal; released with a fair amo of mainline around fluke; some blood noticed around caudal peduncle
	10/25/94	Grampus	39 44	70 54	hooked in mouth; animal released with hook in mouth and approximately 7 fatho of 400lb test line trailing from mouth
	10/27/94	Grampus	39 46	70 56	apparently hooked in mouth; appeared to be wound up the midsection of the bod with line; animal swam off quite sluggishly
A54005	12/9/94	Pilot whale	35 42	74 42	alive; gear around flipper
	12/9/94	Pilot whale	35 42	74 42	alive; gear around body
F15	6/18/94	Pantopical Spotted dolphin	27 37	88 25	alive; tail wrapped in dropline; all line removed
F16	7/14/94	Atlantic spotted dolphin	29 07	87 20	alive; hook in corner of mouth, gangion line wrapped around mouth; line was removed but hook remained
A53034	8/30/95	Pilot whale	46 13	40 07	animal cut free; swam away quickly
A41031	8/9/95	Pilot whale	40 20	67 55	cut loose with leader still attached- line parted as it neared the vessel; "mouth hooked"
	8/12/95	Grampus	40 25	67 30	hooked in mouth; gangion cut to free animal; alive
A25041	8/10/95	Pilot whale	40 15	67 53	alive; animal hooked or maybe wrapped in mono; condition unknown
A44040	8/4/95	Pilot whale	37 33	74 10	hooked in flipper; cut from gangion; alive
	8/13/95	Grampus	39 25	72 02	alive; mainline and gangion wrapped around tail; all gear cut before animal released
A62058	8/11/95	Pilot whale	37 01	74 31	animal extensively wrapped in mainline around caudal peduncle; most of the li cut away; animal released with the remaining line trailing

Table 8. Continued.

Trip #	Date	Species	Lat	Lon	Comments
A62058	8/14/95	Pilot whale	37 09	74 24	gear cut from animal; alive
A41032	8/30/95	Pilot whale	38 04	73 46	mouth hooked; line snapped and animal swam off
A44043	8/31/95	Grampus	39 43	71 49	mainline cut from around tail flukes and pulled from mouth; animal swam away quickly
	9/3/95	Pilot whale	39 05	72 30	hooked in flipper; gangion broke off as it was hauled
	9/7/95	Grampus	39 05	72 32	mainline cut from around tail flukes; animal swam off slowly after blowing
A62071	9/27/95	Pilot whale	38 17	73 33	hook imbedded in caudal peduncle; one or two wraps of the gangion along with t hook were left in the animal; sluggishly swam away
	9/28/95	Shortfin Pilot whale	38 21	73 31	hooked in mouth; gangion clipped as close to the mouth as possible; released with hook in mouth
A41034	10/4/95	Pilot whale	37 00	74 36	animal swam away after breaking line; condition unknown
	10/10/95	Pilot whale	35 43	74 37	hooked in mouth; leader cut to free animal; condition unknown
	10/11/95	Pilot whale	35 46	74 42	leader cut to free animal; condition unknown
	10/11/95	Pilot whale	35 46	74 42	same as previous entry except animal swam towards 3 other "waiting" whales an swam away with them
A44048	10/16/95	Pilot whale	37 45	73 25	hooked in mouth; cut from mainline; swam away trailing gangion and 100 feet o mainline
T12	10/23/95	Pilot whale	26 42	79 40	alive; entangled in mainline, mono cut away
F29	8/4/95	Unid MM	39 24	72 17	animal not seen by observer; crew was pulling in gangion when they noticed it was a mm; line broke and animal swan awaw; crew called out whale; oth large dolphin (unknown) in area

Information provided by M Tork (NEFSC) and D. Lee (SEFSC).

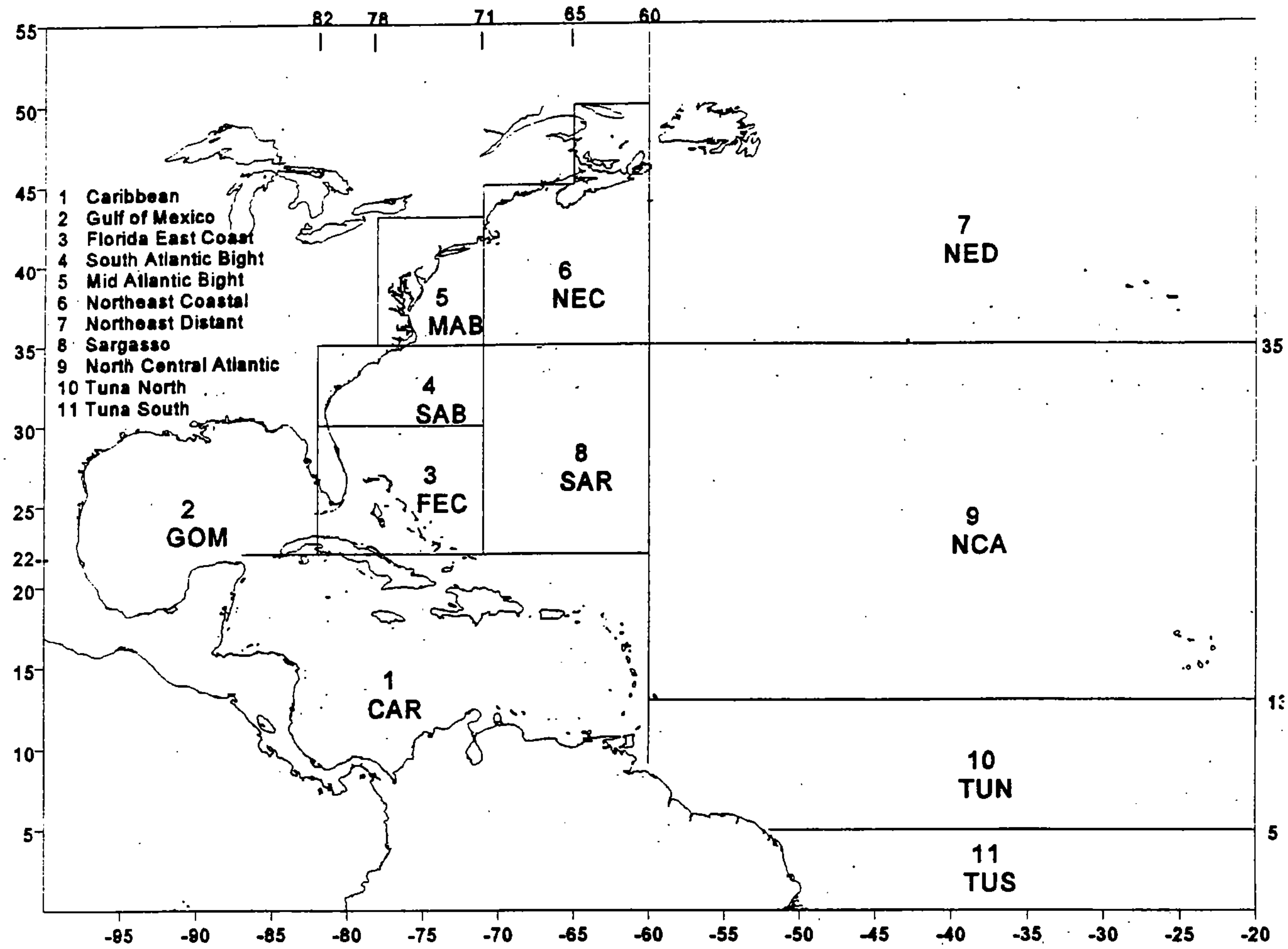


Figure 1. The geographical zones used to classify observed and reported longline fishing effort. For the purposes of estimation, several strata were combined. The Southeast Coastal stratum was defined as areas 3 and 4; the Northeast Coastal stratum was defined as areas 5 and 6; and the Offshore South was defined as areas 8, 9, 10, and 11. Larger regions were also defined as those generally within the US Atlantic EEZ (US Atl: Southeast Coastal plus Northeast Coastal), other Atlantic waters (OthAtl: area 1 plus area 7 plus Offshore South area); and the Gulf of Mexico (area 2 above).

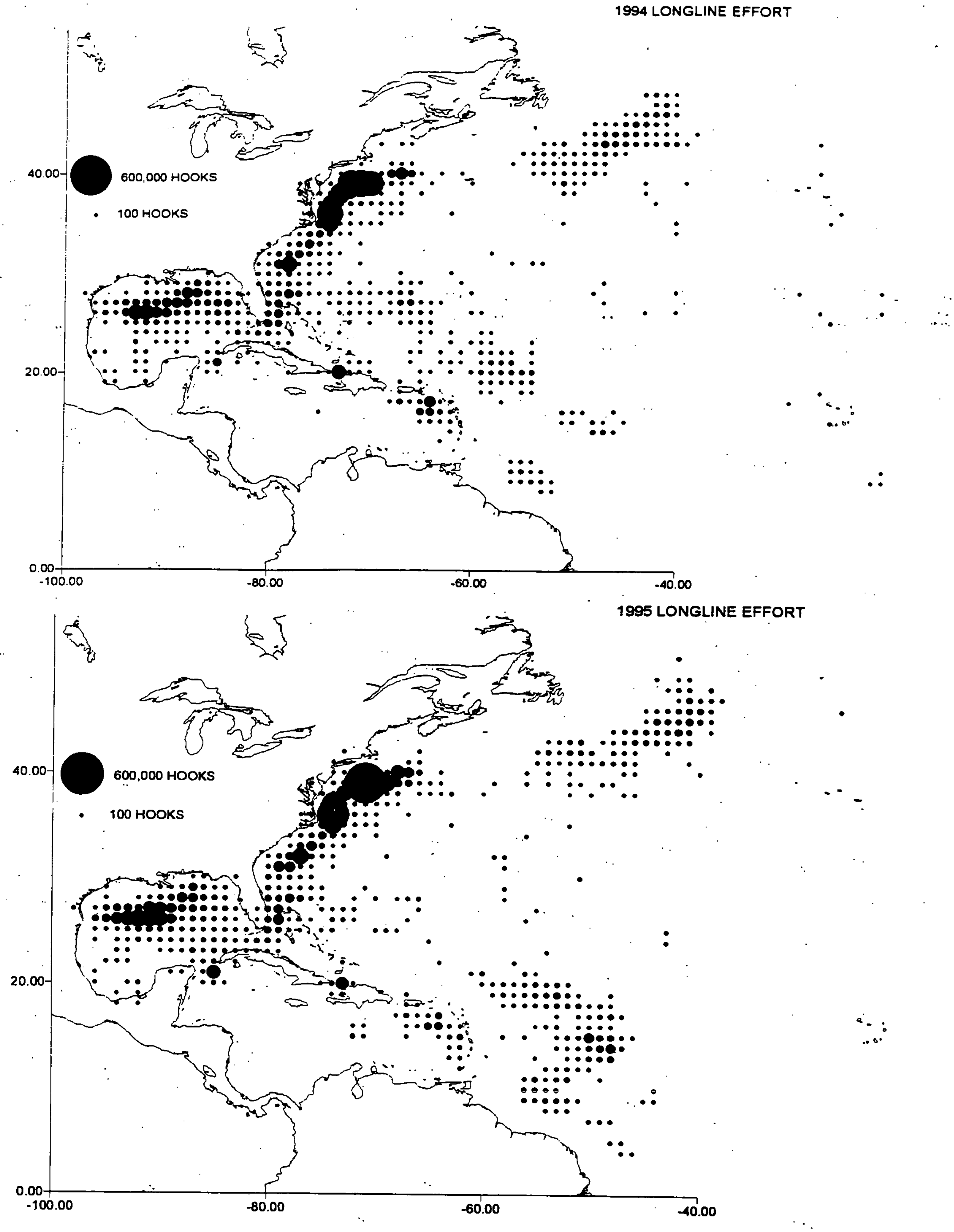
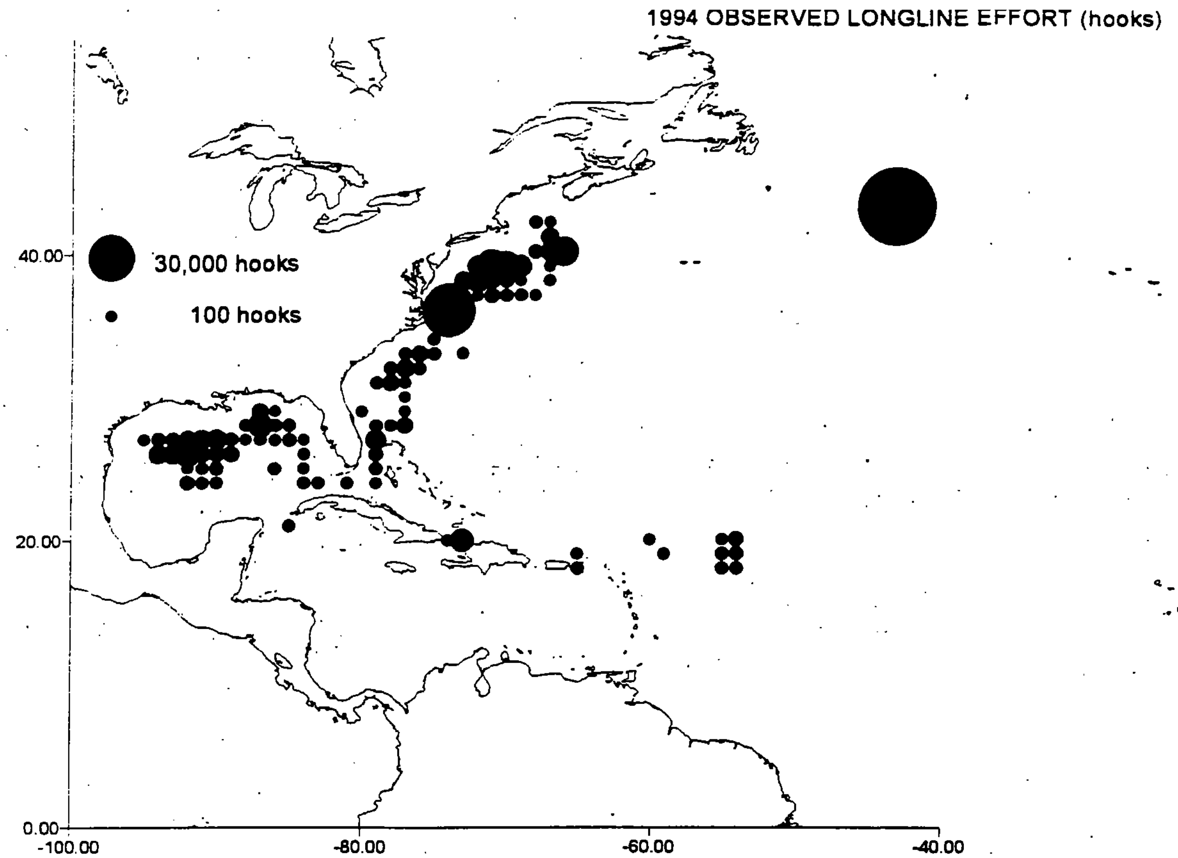


Figure 2. Logbook reported effort distributions for 1994 and 1995. The effort reported (hooks fished) by 1x1 degree blocks is shown. The size of the circle is related to reported hook density in the block for the year indicated.



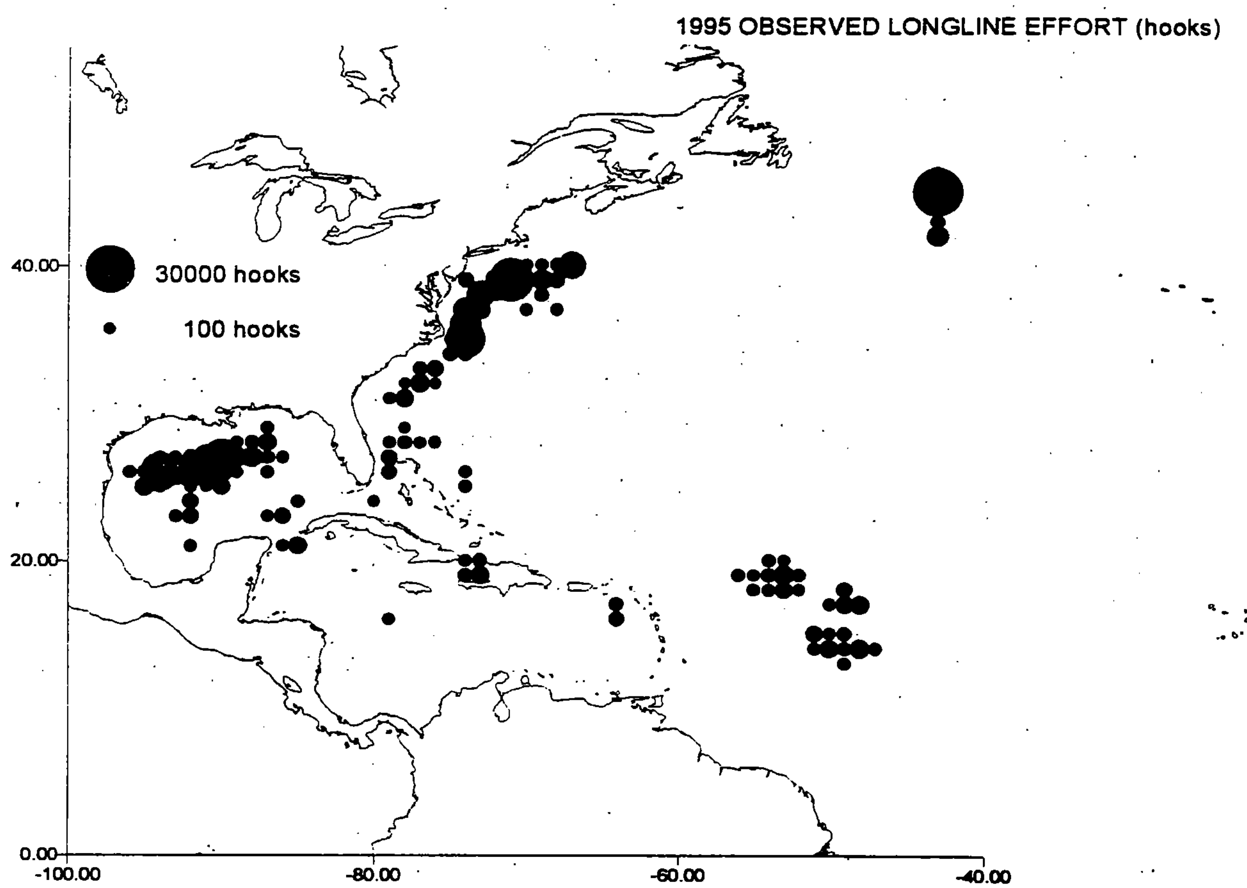
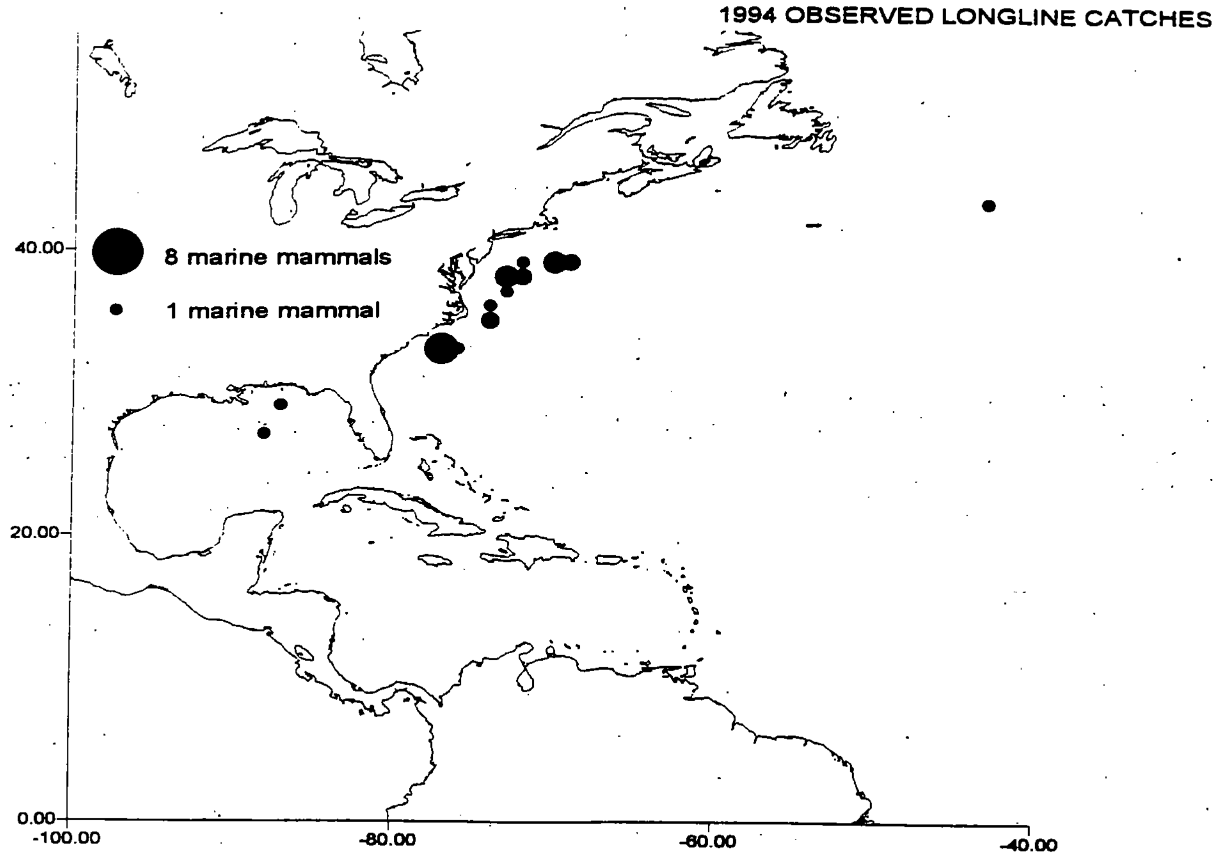


Figure 3. Observed effort distributions for 1994 and 1995. The effort observed (hooks fished) by 1x1 degree blocks is shown. The size of the circle is proportional to hook density in the 1x1 degree block.



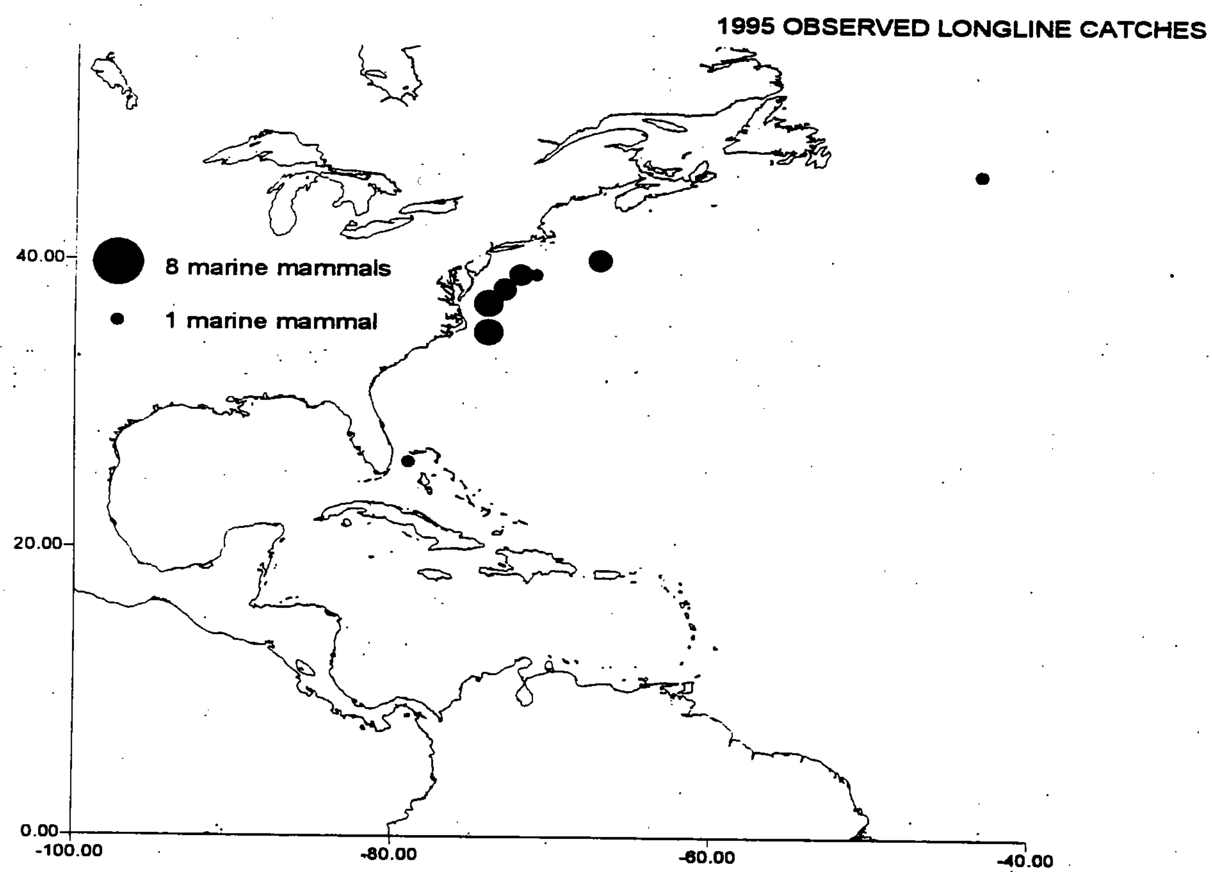


Figure 4. Observed catches of marine mammals in 1994 and 1995. The size of the circle is proportional to the number of marine mammals observed caught in each 1x1 degree block.

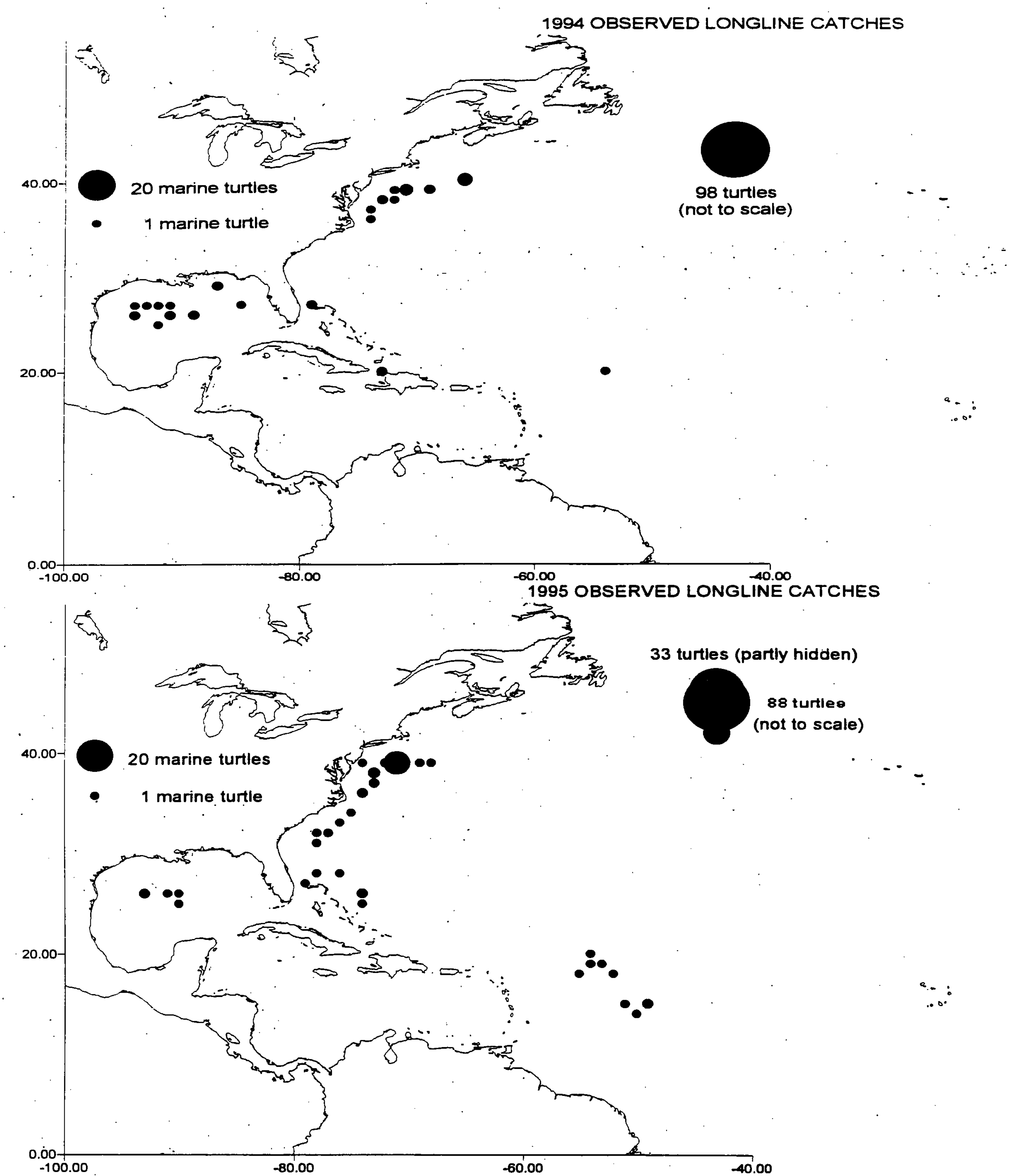
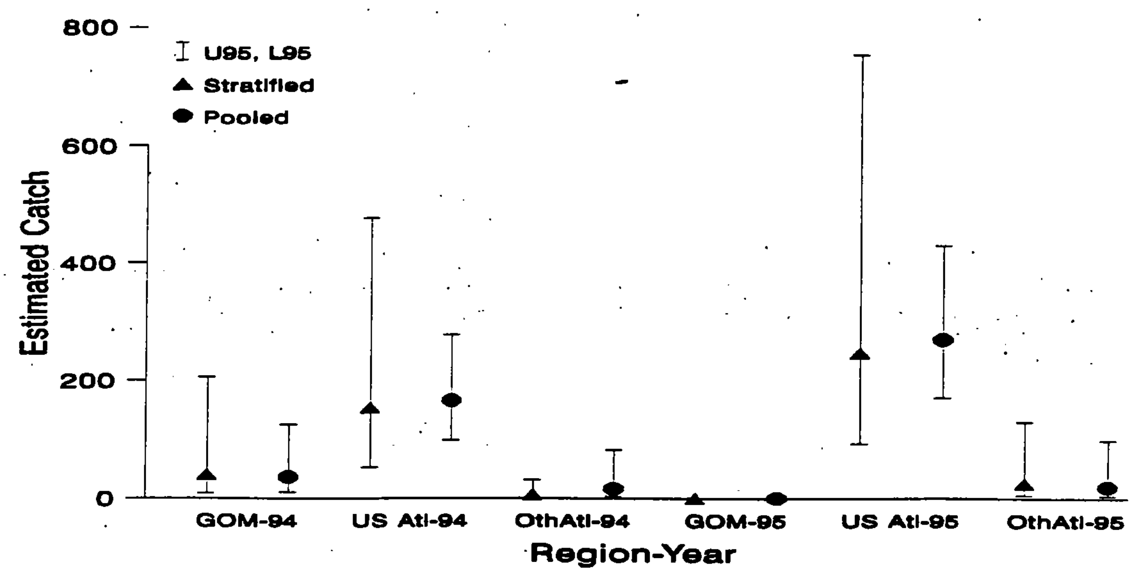


Figure 5. Observed catches of marine turtles in 1994 and 1995. The size of the circle is proportional to the number of marine turtles observed caught in each 1x1 degree square, except as indicated.

Marine Mammals



Marine Turtles

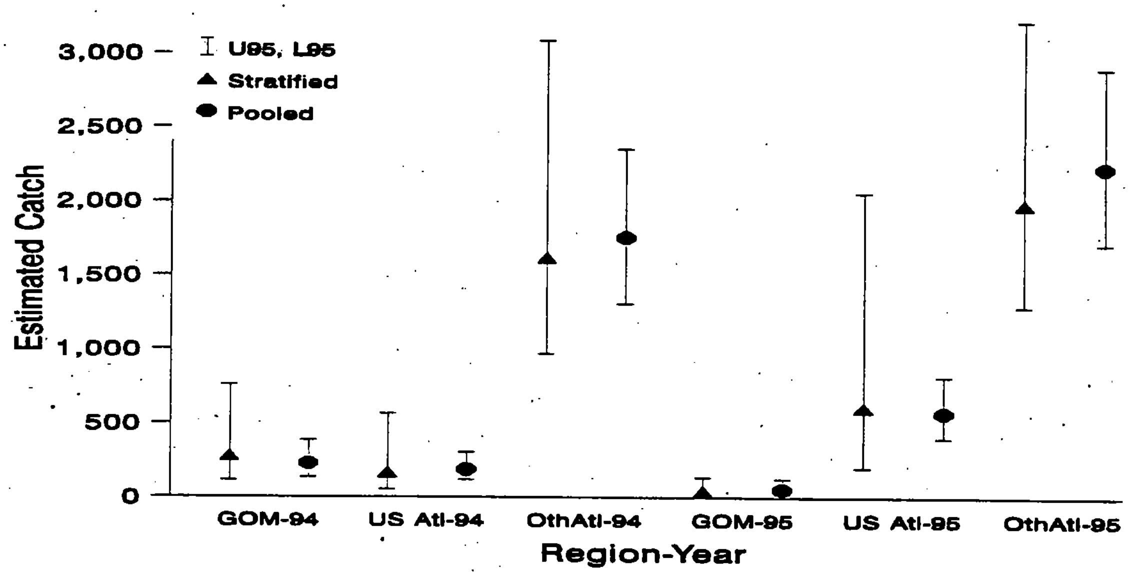


Figure 6. Comparison of stratified and pooled estimates of marine mammal (upper) and marine turtle (lower) catches by the US pelagic longline fleet operating in the Atlantic in 1994-1995. Considerable gains in precision (shown here as approximate 95% confidence ranges, error bars) can be seen about the central estimates in the pooling method. The point estimates are relatively insensitive to pooling as evidenced by the close proximity of the stratified (triangles) and pooled (circles) point estimates. The stratified estimates represent the sum of independent estimates of different species groupings as shown in Table 5, by large ocean regions. The pooled estimates are those shown in Table 6.

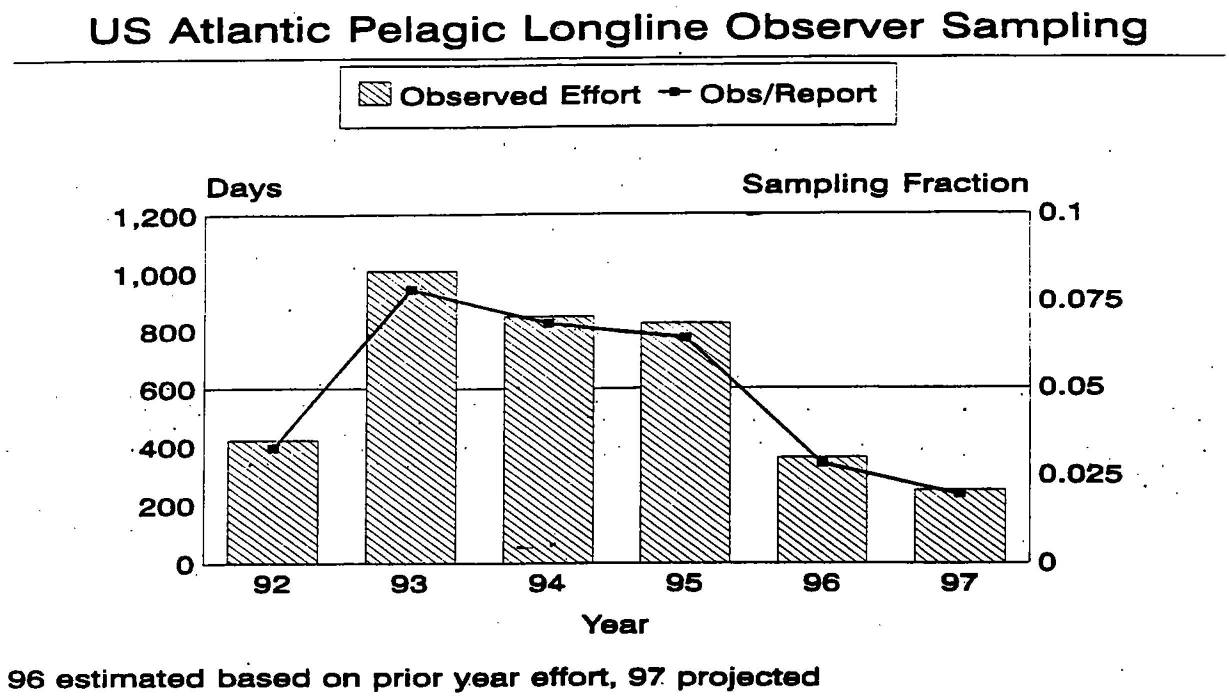


Figure 7. The number of fishing days (bars) observed on board US pelagic longline vessels operating in the Atlantic since 1992. Also indicated are the realized (1992-1995), estimated (1996), and forecast (1997) sampling fractions (Obs/Report, solid squares connected by line). The 1996 sampling fraction is estimated based on the prior 3-year total effort data and the 1997 forecast sampling fraction and days observed are based on projected sampling levels given available resources and expected total fishing effort levels (from prior years). A reference line at the 5% sampling fraction represents the level of sampling agreed to at the 1996 ICCAT Commission meeting (San Sebastian, Spain) for observer sampling of pelagic longline vessels operating in the Atlantic.

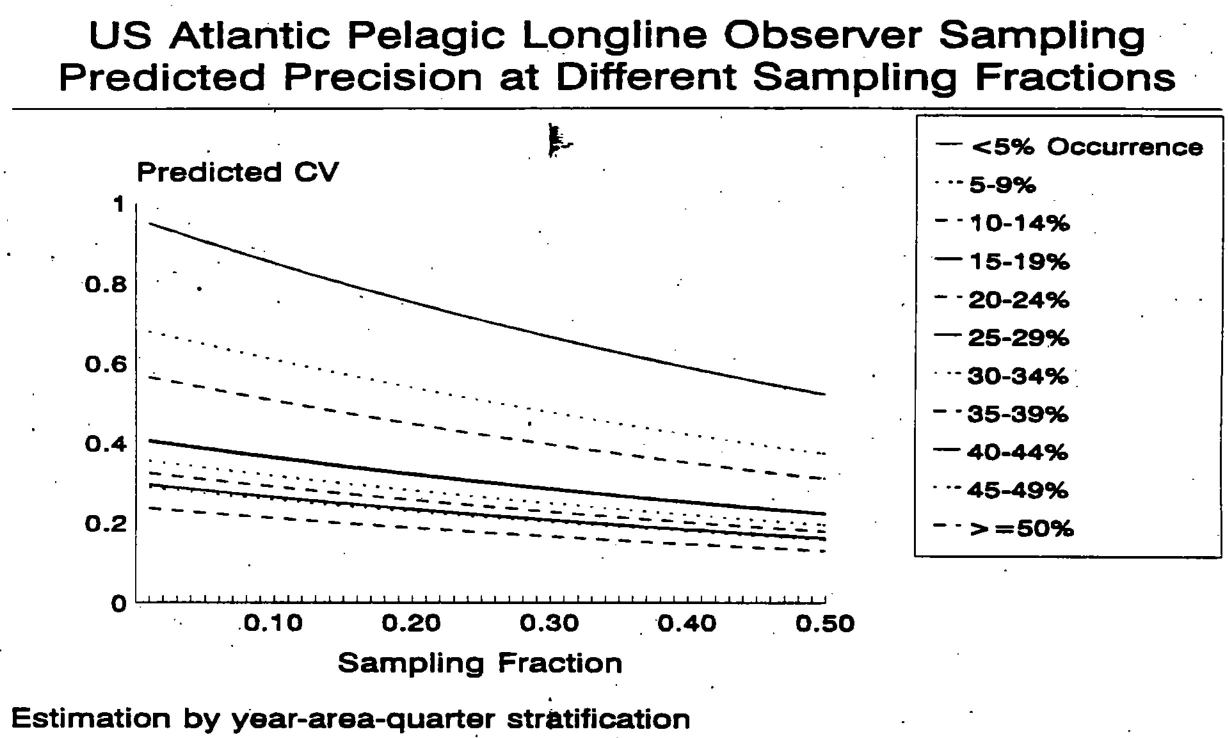


Figure 8. Model predicted coefficients of variation (CV) taking into account the proportion of positive sets (% occurrence column) observed and the sampling fraction (observed sets/reported sets) in the US Atlantic longline observer data base. Estimates with precision less than about 40% for relatively rare event species (those which occur less than about 20% of the time) will likely be difficult to attain at the level of stratification used, unless sampling fractions are relatively large (more than 30%). See Table 7 for analysis results.